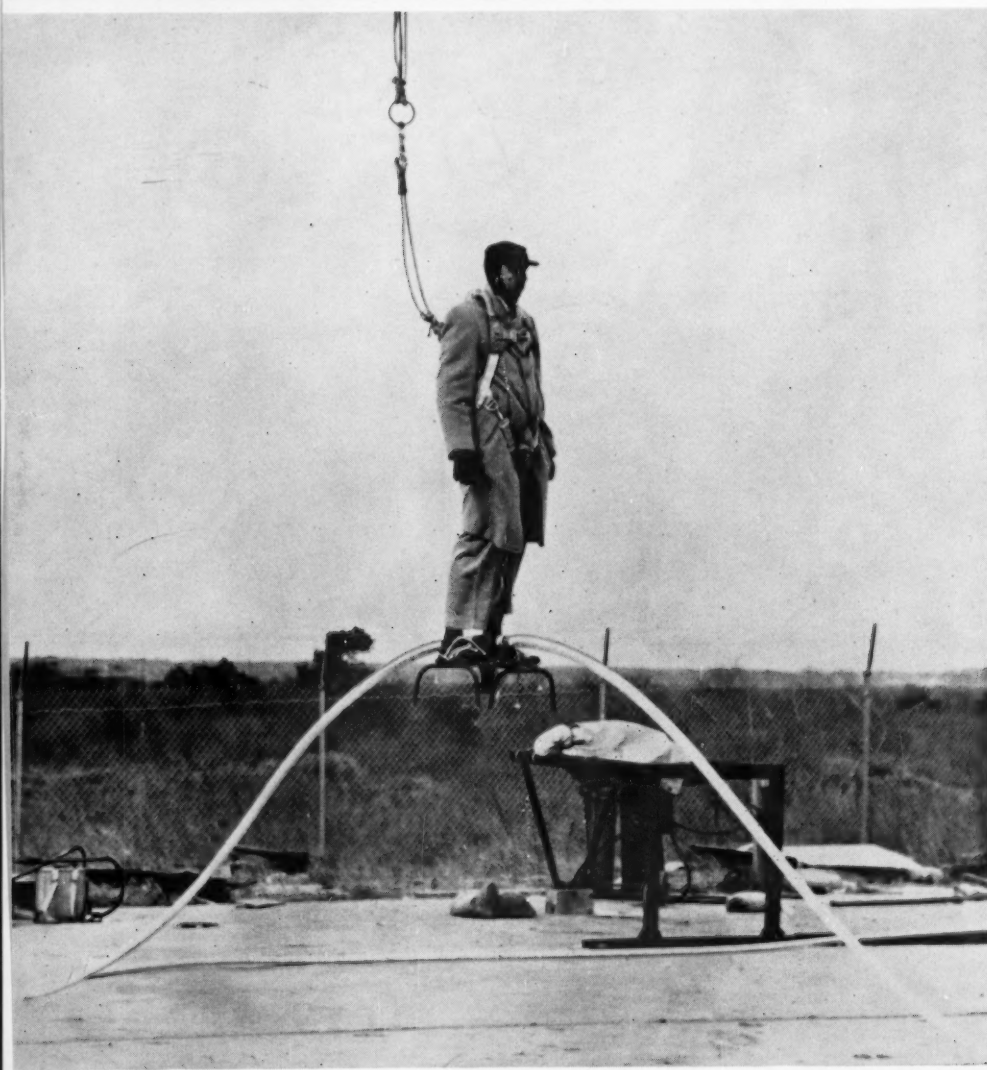


Compressed Air

OCTOBER 1955

Magazine



IT'S ALL DONE
WITH AIR JETS

The same sort of push that
lifts skyrockets keeps
him off the ground

INTERNATIONAL NEWS PHOTO

VOLUME 60 • NUMBER 10

NEW YORK • LONDON

Cool savings for Hotpoint...

For the past five years, Hotpoint Co., Milwaukee, has been using *Texaco Regal Oil R&O* for all its air compressor lubrication. And here's what L. E. Sweet, Plant Manager, has to say about it:

"Texaco Regal Oil R&O has done a consistently fine job for us. It keeps systems free of rust and harmful deposits — and we haven't had to replace a compressor bearing since we started using it."

Operators everywhere find that *Texaco Regal Oil R&O* assures them high efficiency, dependable performance and low maintenance costs. *Texaco Regal*

Oil R&O is premium-quality oil that has been *further improved* by effective additives and extra processing.

There is a complete line of *Texaco Regal Oils R&O* to meet the requirements of all compressors and operating conditions. A Texaco Lubrication Engineer will gladly help you select the proper one. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135
East 42nd Street, New York
17, N. Y.



HOTPOINT'S GOLDEN ANNIVERSARY is being celebrated this year and Texaco salutes this "Pioneer of the All-Electric Kitchen." We are proud that Texaco Lubricants and Lubrication Engineering Service are so widely used to help speed production of the famous Hotpoint kitchen and laundry appliances.



TEXACO Regal Oils R & O

FOR ALL AIR COMPRESSORS AND OPERATING CONDITIONS

TUNE IN... TEXACO STAR THEATER starring JIMMY DURANTE on television... Saturday nights, NBC.

Circle 1A on reply card

SPECIFY

STAYNEW

PIPE LINE FILTERS

FOR CLEAN, DRY AIR

**GUARD
AGAINST**

**WATER
OIL
PIPE SCALE**

Staynew's "double-action principle" assures sustained, trouble-free operation at high load factors.

1. Deflector cup directs flow of air or gas, together with water, oil and dirt, to the walls of the housing and then downward at high velocity into the base, where water, oil and heavier particles of rust, scale and dirt are deposited.

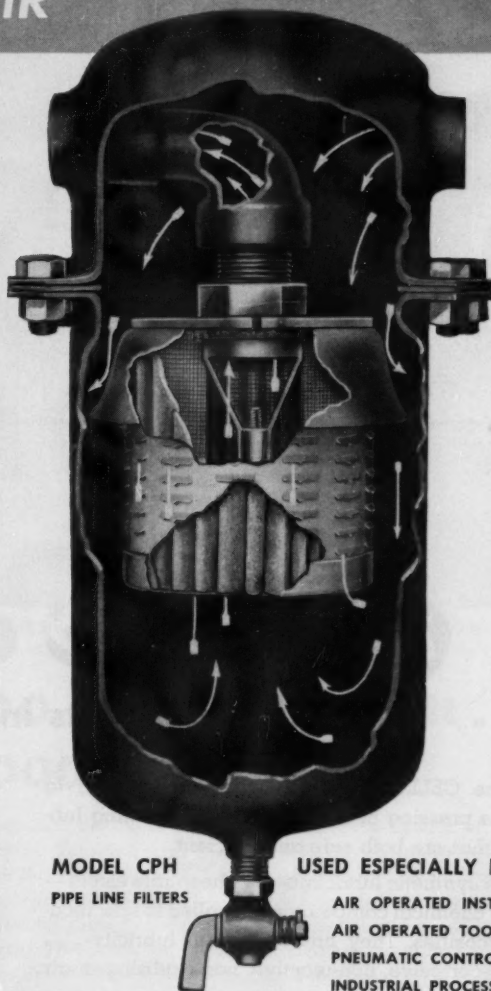
2. The air or gas having been mechanically cleaned, rises at low velocity through the Radial Fin Filtering Insert which removes the lighter air-borne material.

Efficient design eliminates need for frequent cleaning. Interior parts of filters are easily accessible for inspection and cleaning.

Inexpensive, quickly installed and easily maintained, these filters keep air operated or controlled equipment free from pipe scale, dust, dirt, and condensate. Wherever you require air and other gases *clean and dry*, specify Staynew Pipe Line Filters.

WRITE

for Bulletin 200 containing photos, charts and engineering data. Our Engineering Department welcomes the opportunity to help solve your air filtration problems.



**MODEL CPH
PIPE LINE FILTERS**

USED ESPECIALLY FOR:

**AIR OPERATED INSTRUMENTS
AIR OPERATED TOOLS
PNEUMATIC CONTROLS
INDUSTRIAL PROCESSES**

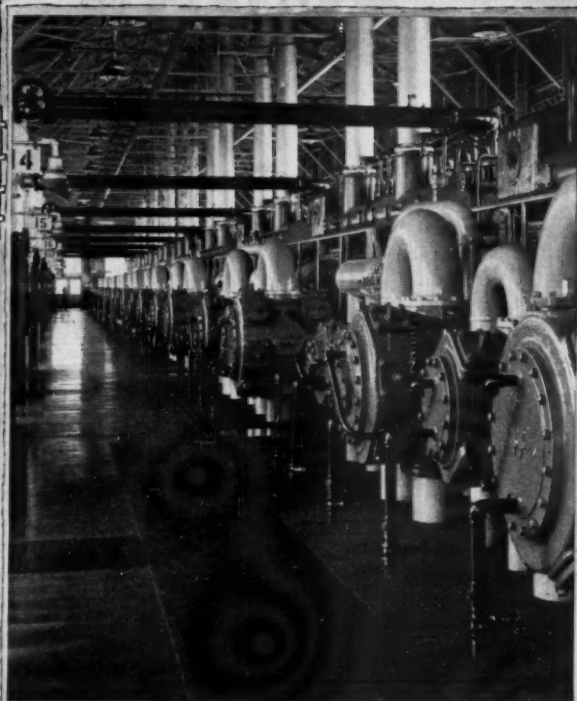
**DOLLINGER
PROTECTOMOTOR
STAYNEW FILTERS**

DOLLINGER
CORPORATION

7 CENTRE PK., ROCHESTER 3, N. Y.

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

Now-
for air compressors
FIRE-RESISTANT
 Safer **LUBRICATION!**



Battery of 1100 H.P. Compressors at Celanese petrochemical plant, Bishop, Texas: where CELLULUBE* 220 has given efficient service since 1952.

Celanese* CELLULUBE*s

synthetic lubricants in controlled viscosities

Celanese CELLULUBES have been developed to meet the pressing need for non-carbon-forming lubricants that are both safe and efficient.

These synthetic lubricants are phosphate esters—straight chemical compounds controlled to specification viscosities. They have excellent lubricity . . . are non-corrosive, non-reactive, non-oxidizing in air compressor service.

CELLULUBES are non-petroleum oils. They greatly

reduce the formation of carbon deposits, a prime source of air compressor explosions and fires.

CELLULUBES have been job-tested for 3 years in actual compressor installations. Evaluate them in your own operation. Use coupon below to order samples and complete technical data.

Celanese Corporation of America
 Chemical Division, Dept. 596-J
 180 Madison Avenue, New York 16, New York.

Celanese Corporation of America, Chemical Division, Dept. 596-J
 180 Madison Avenue, New York 16, N. Y.

Please send me sample and technical bulletin on Cellulube fire-resistant Synthetic Lubricants for air compressor service.

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____



*Reg. U.S. Pat. Off.



Engineers: Stone & Webster Engineering Corp., Boston, Mass.; Excavation Contractor: Central Engineering and Construction Corp., Durham, N. C.

This rail-mounted drill carriage, equipped with Bethlehem Hollow Drill Steel, was used in making blast holes for first lift of 8,000-ft tailrace for Roanoke Rapids Dam in North Carolina. Tailrace is part of hydroelectric project for Virginia Electric & Power Co.

Solid Granite . . . 1,000,000 cu yd of it . . . Blasted for 8,000-ft Tailrace

Excavating an 8,000-ft tailrace, 80 ft wide and from 56 to 31 ft deep, would be a difficult enough task even in relatively soft earth. But when it calls for the removal of more than a million cu yd of solid granite, the project assumes gigantic proportions.

That was the problem confronting engineers for the new Roanoke Rapids Dam, at Roanoke Rapids, N. C. This huge structure is part of a hydroelectric project for Virginia Electric & Power Co. The lengthy tailrace was planned to obtain full hydraulic advantage from the long rapids at minimum cost.

Bethlehem Hollow Drill Steel, fitted

with carbide-insert bits, was used in the rock-removal operations. To speed the work, the drill carriage illustrated, mounting 14 wagon drills, was used to drill blast holes for the first lift through the tailrace's entire length. The holes, on 5- to 7-ft centers, were drilled 24 to 30 ft deep. After mucking, individual wagon drills were used to make blast holes in the second and third lifts, because of the uneven surface.

Bethlehem Hollow Drill Steel is ideal for steady, economical drilling because it is rolled from a top-quality grade of fatigue-resisting steel. It has a wide quenching range, and is easy to heat-

treat for the ideal balance of hardness and wear-resistance. It also makes long-wearing threads and tough shanks.

Bethlehem Hollow is available in rounds, hexagons and quarter-octagons, and is generally furnished in lengths ranging from 18 ft to 25 ft. It is also supplied in longer lengths, to meet special requirements. It's good steel to keep in mind for your next drilling job!

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation



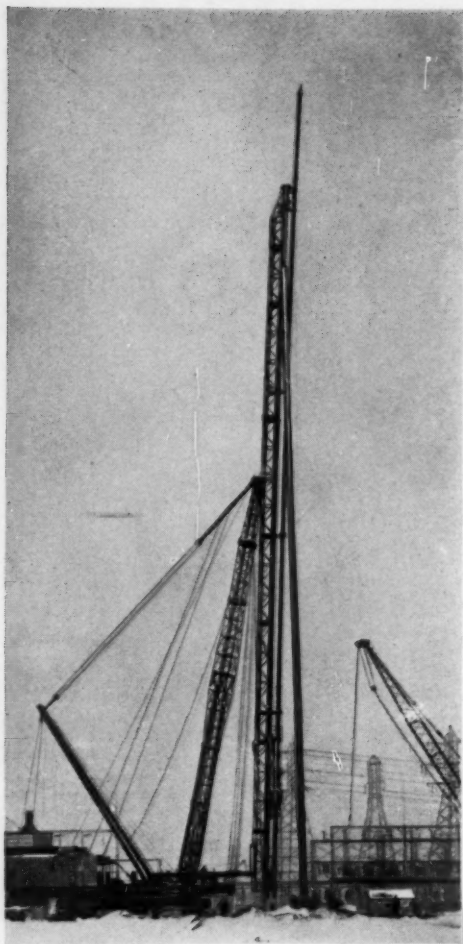
BETHLEHEM HOLLOW DRILL STEEL

OCTOBER, 1955

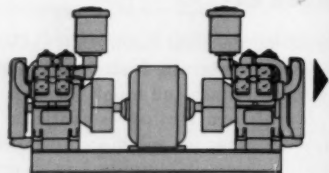
Circle 3A on reply card

Circle 4A on reply card

Adv. 5



▲
This pile driving and jetting rig, designed by Raymond engineers, is one of the tallest in existence, with a 112 ft boom and 220 ft jetting pipe which had to be equipped with an aircraft warning light.



Ten Ingersoll-Rand Type 40 two-stage compressors supplied 100 psi air for the jetting work on this 200-ft pile driving job. They are mounted back-to-back in pairs, with a 200-hp driving motor direct connected to each pair of compressors. These I-R units operated a total of 18,000 machine hours without a single breakdown.

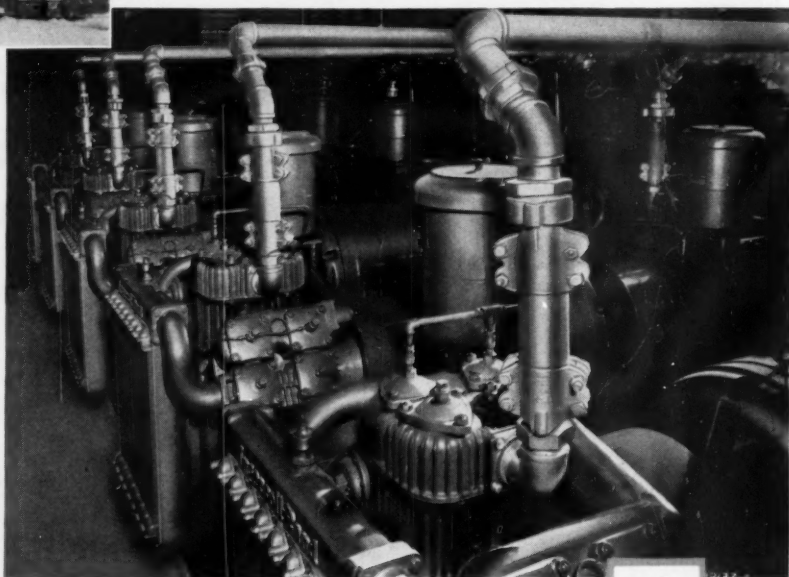
Ingersoll-Rand air-cooled compressors are available in units of $\frac{1}{4}$ to 250 horsepower.

1,000 horsepower of Air-Cooled Compressors help drive 200 FT. PILES

To get down to bed rock on a large power plant construction job, the Raymond Concrete Pile Company had to sink 24" steel pipes 180-ft long to a total depth of 200 ft. In order to start and drive these king-size piles, air and water jetting was first used to sink a 30" casing 50 ft down through the relatively soft overburden. The 180-ft pile pipes were then inserted in the casing, driven down to solid rock, cleaned out by jetting and filled with concrete.

The large volumes of air needed for the jetting work were provided, at 100 psi, by ten Ingersoll-Rand Type 40 compressors, mounted back-to-back in pairs, each pair driven by a 200-hp motor as shown below. These compact, air-cooled two-stage compressors proved well suited to this type of construction work. They are easy to move and install, give wide flexibility of air capacity, require no water connections and can be used in the coldest weather without danger of freezing.

For dependable air power at lowest overall cost, it pays to specify Ingersoll-Rand compressors. They are available for handling air or gas at any pressure or capacity. Ask your I-R representative for further details.



Ingersoll-Rand

1-269

11 BROADWAY, NEW YORK 4, N. Y.



COMPRESSORS • PUMPS • AIR AND ELECTRICAL TOOLS • VACUUM EQUIPMENT • ROCK DRILLS • CONDENSERS • GAS AND DIESEL ENGINES

COMPRESSOR FACTS ON INDUSTRY'S
MOST PREFERRED "POWER PACKAGE"



FACT: The new ***Life-Line A***
has stronger insulation than
any motor on the market

Meaning what? Simply that the new Westinghouse Life-Line® "A" motor with new *fortified insulation* can withstand heavier overloads and operate at higher temperatures than any other motor you can buy. That's electrical system improvement!

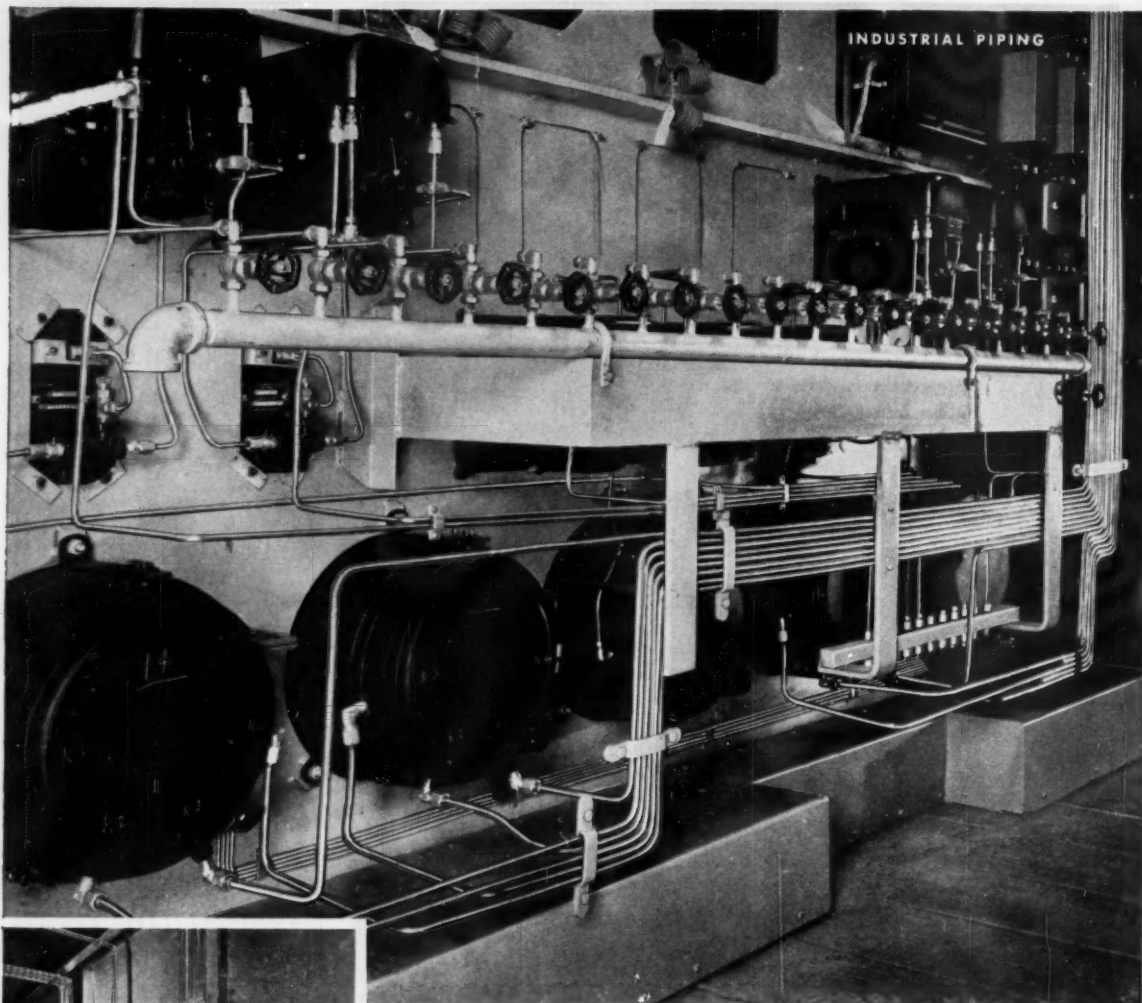
There are equally important advances in the Life-Line "A" mechanical and lubrication systems. It takes the right combination of *all three systems* to build industry's most preferred "power package".

Westinghouse builds a complete line of motors from 1 to 700 hp for compressor applications everywhere. Get all the facts from your Westinghouse sales engineer—The Man With The Facts.

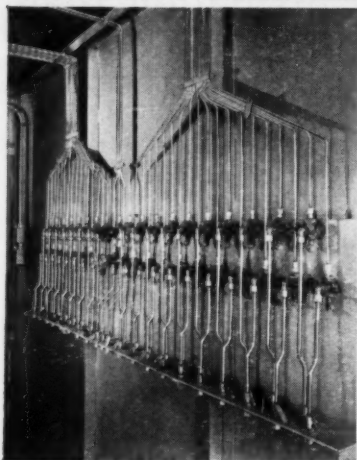
J-21894

YOU CAN BE SURE... IF IT'S
Westinghouse





THESE AIR SIGNAL LINES in Toronto's Richard L. Hearn Power Station use copper tube in long lengths, change direction and avoid obstructions without fittings.



MOIST COMPRESSOR AIR can never form rust or scale to impede control in this installation made by Bailey Meter Co., Ltd.

CONTROL would be impaired if moisture could create rust or scale in these pneumatic control lines for coal-pulverizing equipment installed by Bailey Meter Company, Limited, in Toronto's Richard L. Hearn Power Station. A number of these copper tubes

Wet air can't rust this copper control piping

convey differential pressures to the pulverizer feeder controllers, while others transmit an air signal to the pulverizers to selectively limit the rate of coal feed. Rust particles which might interfere with the satisfactory operation of the control system cannot form, and the smooth bore keeps flow resistance at a minimum.

Here, as in all copper tube systems, the long lengths, the light weight and the elimination of many fittings by bending all make important savings in installation costs. Where flare or solder-type fittings are used, there are no threads to cut, and connections stay tight.

Publication C-24 offers many addi-

tional facts on how ANACONDA Copper Tubes can help improve product quality, reduce operating and maintenance costs and avoid costly shutdowns. Write to: *The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.*

5390A

call your

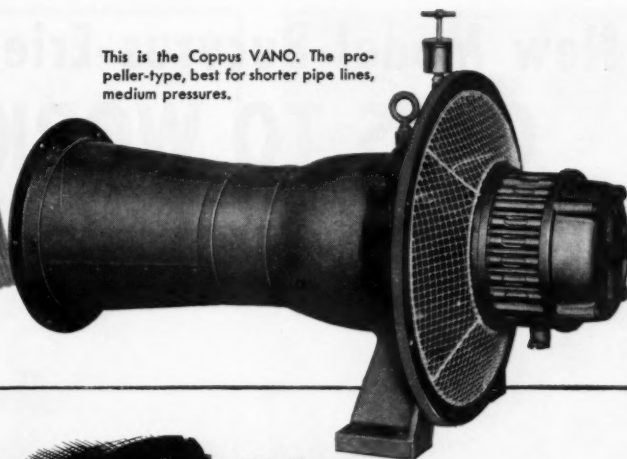
ANACONDA[®]

distributor for

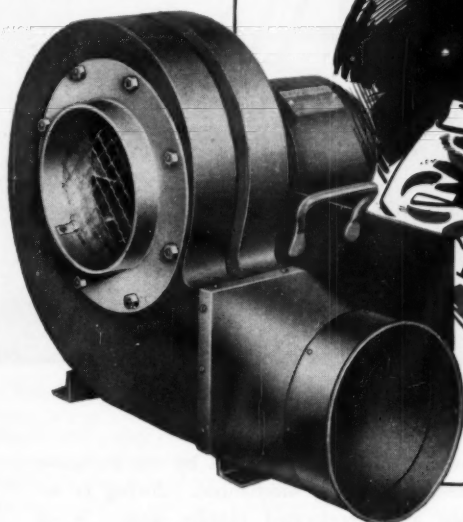
Copper tubes and fittings for industrial process lines, water, heating and sanitary drainage systems; American Flexible Metal Hose and Tubing; American Vibration Eliminators.

ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

This is the Coppus VANO. The propeller-type, best for shorter pipe lines, medium pressures.



This is the Coppus VENTAIR. A centrifugal blower, it is designed for long pipe lines, high pressures.



These are the cost-reducing Blowers that give up to 100% more air

Only Coppus makes both types — and both are made especially for *mine* ventilation. One or the other, operating under the conditions for which it is designed, delivers from 30% to 100% more air for a given power consumption than an ordinary all-purpose fan.

They can be used as blowers or exhausters and are driven either by compressed air or electric motor, with capacities up to 90,000 CFM. Like all Coppus products, these blowers wear the "Blue Ribbon" that stands for high achievement in engineering, workmanship and performance.

Representatives listed in MINING CATALOGS. Other Coppus "Blue Ribbon" products: steam turbines, gas burners, heat killers, air filters, blowers and exhausters

for special purposes. See also *THOMAS' REGISTER* . . .
Coppus Engineering Corp., Worcester 2, Mass.

COPPUS ENGINEERING CORPORATION
210 Park Avenue, Worcester 2, Mass.

Please send.....Bulletin 130

Name.....

Company.....

Address.....

New Model Bucyrus-Erie Walking Dragline GOES TO WORK IN FLORIDA PHOSPHATE FIELDS



770-B

Electrically Driven
with
Ward Leonard Control

The first Bucyrus-Erie 770-B Walking Dragline was shipped recently to the phosphate fields near Bartow, Fla. It's the first installation of this particular model, but it's not a first for the stand-out features which forecast success for this newest member of the Bucyrus-Erie line. The 770-B will be at home on its multi-million yard assignment because of high output features such as these:

The dragline's all-welded boom, composed of T-section chord members with tubular bracing, combines maximum strength for carrying heavy payloads with minimum deadweight that keeps swing inertia and roller loads low. Excellent

maneuvering ability is provided by the exclusive Bucyrus-Erie walking mechanism. Swing is accelerated and decelerated rapidly under Ward Leonard rotating control . . . digging and hoisting are fast, too, because both the drag and hoist drum units have their own individual motor drive.

These are only a few examples of the many 770-B features that mean outstanding performance in all stripping or other long range excavating operations requiring bucket sizes of 18 and 14 cu. yds. with corresponding boom lengths of 195 and 225 feet.

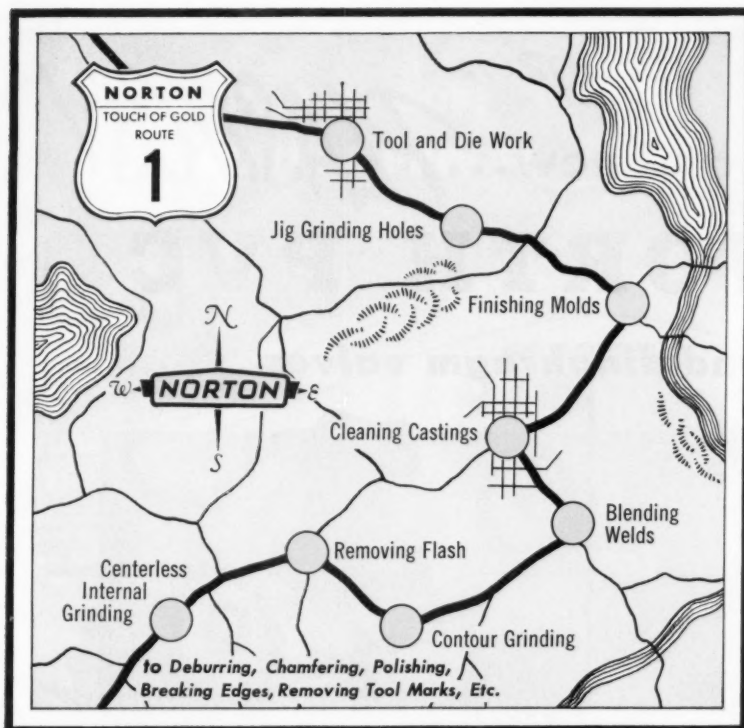
41L55

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ERIE**

South Milwaukee
Wisconsin

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YEARS OF SERVICE
to Men Who
Shape the Earth



NEW THRU-WAY OPEN!

NORTON MOUNTED WHEELS AND POINTS

chart your "TOUCH of GOLD" Route to hard-to-reach grinding spots

You by-pass trouble, save time and costs, when you use Norton mounted wheels and points to reach those hard-to-get-at grinding areas. That's because Norton builds into every one of them the same "Touch of Gold" performance that you get with all Norton wheels.

They're trued on their own spindles. This not only gives them perfect concentricity plus accuracy of dimensions and shape. It also assures sharpness and fast-cutting action from the start — no breaking-in needed.

They stay TIGHT on their spindles under toughest use — thanks to Norton-developed mounting techniques.

They're identically duplicated. Norton's

statistical quality control makes sure you'll get top performance with every re-order.

The line of Norton mounted wheels and points is 100% complete, covering all applications. Available in all required abrasive and bond types, including diamond abrasives and laminated BF construction. Special spindles and cement available for ultra-high speed precision grinding.

See your Norton Distributor or write to NORTON COMPANY, Worcester 6, Mass. Distributors in all industrial areas, listed under "Grinding Wheels" in your phone directory, yellow pages. *Export:* Norton Behr-Manning Overseas Incorporated, Worcester 6, Massachusetts.

W-1650



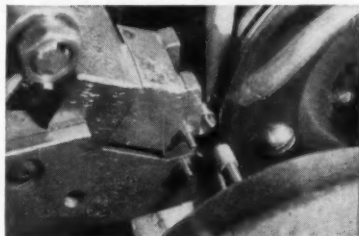
*Making better products...
to make your products better*

and its BEHR-MANNING division

NORTON COMPANY: Abrasives • Grinding Wheels • Grinding Machines • Refractories
BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure Sensitive Tapes



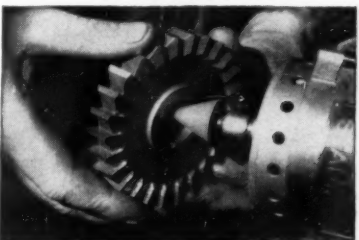
Finishing a die



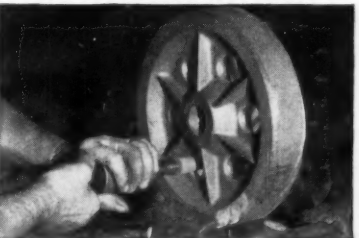
Centerless internal grinding



Smoothing a mold



Chamfering



Cleaning a casting

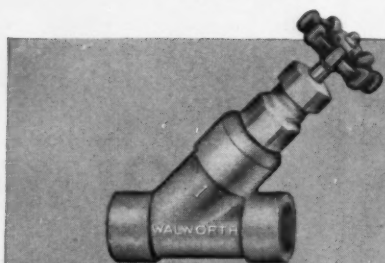


Deburring a slot

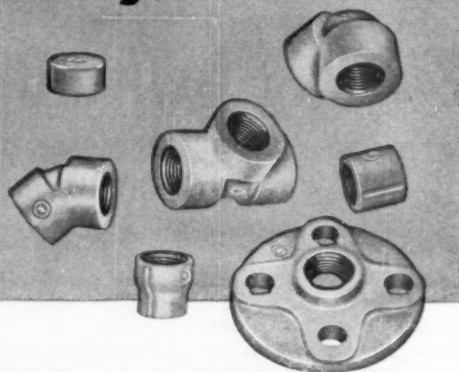
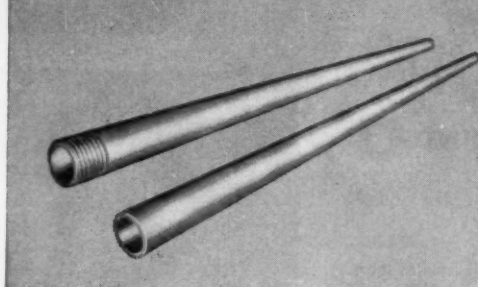
*Iron... Steel... Bronze...
Special Alloys and now... **PLASTICS!***

WALWORTH PVC

globe and diaphragm valves



pipe and fittings



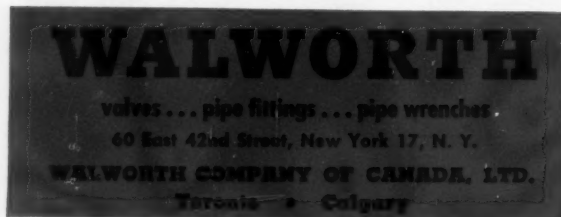
CORROSION-RESISTANT TO GIVE YOU NEW AND LASTING PROTECTION!

Walworth rigid plastic polyvinyl chloride valves, and fittings provide safe, trouble-free lines to handle wet and dry hydrogen gas—sulphur dioxide—dilute nitric acid—sulphuric acid—natural gas—sugar juice—milk—vinegar—tanning solutions and literally scores of other corrosive as well as noncorrosive materials in the chemical, petroleum, pulp, paper, food and other industries.

Walworth polyvinyl chloride valves and fittings are molded to the *same* rigid Walworth specifications by the *same* molder—the General American Transportation Corporation—of the *same* basic material,—Geon rigid vinyl from B. F. Goodrich Chemical. Rigid plastic pipe of the same materials and made by the same molder is also available. Consistent performance is therefore assured throughout *all*-Walworth PVC piping systems. Plastic valves, fittings, and pipe offer the following advantages:

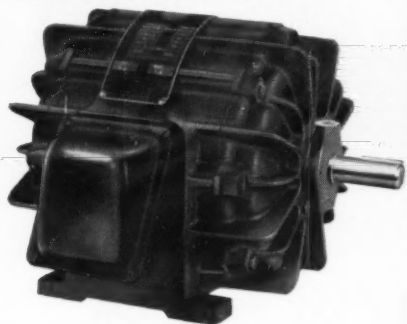
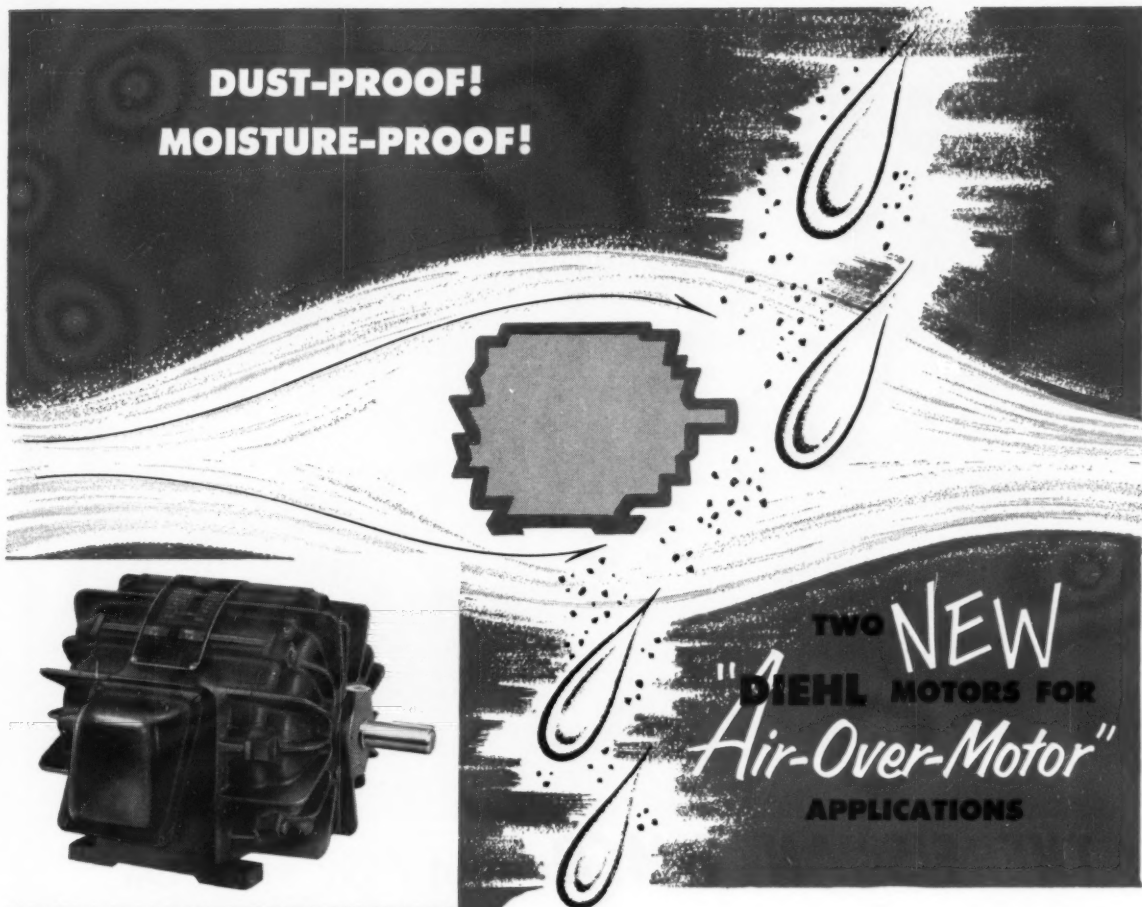
1. Exceptionally resistant to most salts, alkalis, and nonoxidizing acids at temperatures below 150° F.
2. High burst strength and impact resistance.
3. Nontoxic, and extreme low flammability.
4. Easy to install.

Get the complete Walworth PVC product story. Write for brochure containing detailed specifications, characteristics, and application data.

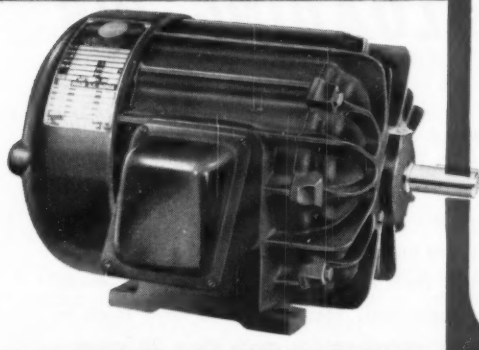


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**DUST-PROOF!
MOISTURE-PROOF!**



Type "DIE" Motor (Not Fan-Cooled)



Type "DIF" Motor (Fan-Cooled)

**Tops in Quality—
Competitive in price!**

TWO NEW
"DIEHL" MOTORS FOR
Air-Over-Motor
APPLICATIONS

When you buy or specify motors for fans, blowers, unit heaters, air conditioners, cooling towers or dehumidifying systems *don't overlook* these two new standard or custom-designed Diehl Totally-Enclosed Motors.

Smaller in size, lighter in weight, precision-engineered and precision-built to new NEMA standards, they are ideally suited to "air-over-motor" applications where moisture, fumes, dust and other airborne particles are a problem...a field in which Diehl has long been a leader.



DIEHL MANUFACTURING COMPANY

Electrical Division of THE SINGER MANUFACTURING COMPANY
Finderne Plant, SOMERVILLE, N. J.

Please send me the following bulletins:

- ☐ New Type "D" Motor Bulletin No. CA-3304
- ☐ Consolidated Catalog & Price List No. CA-3310

Name

Company

Street

City State

INTEGRAL AND FRACTIONAL HORSEPOWER MOTORS ARE AVAILABLE IN A WIDE RANGE OF TYPES AND SIZES



THERE'S AN EIMCO TO FIT YOUR LOADING JOB

There is an Eimco loader for your loading job. Small or large tunnels, drifts, slopes, inclines, haulage ways, overburden, cleanup, road building, clearing slides or any loading job that requires speed, economy and continuous operation with minimum machine attention.

Eimco loaders are available with wheels for rail type operation and crawler mounts for trackless work. They are self propelled by air,

electric and diesel motive power, depending on their type of application.

Eimcos are proved loaders — more of them are in daily use on hard rock mining jobs throughout the world than all other brands of mechanical loaders combined. Many of these have been in continuous operation for more than 20 years.

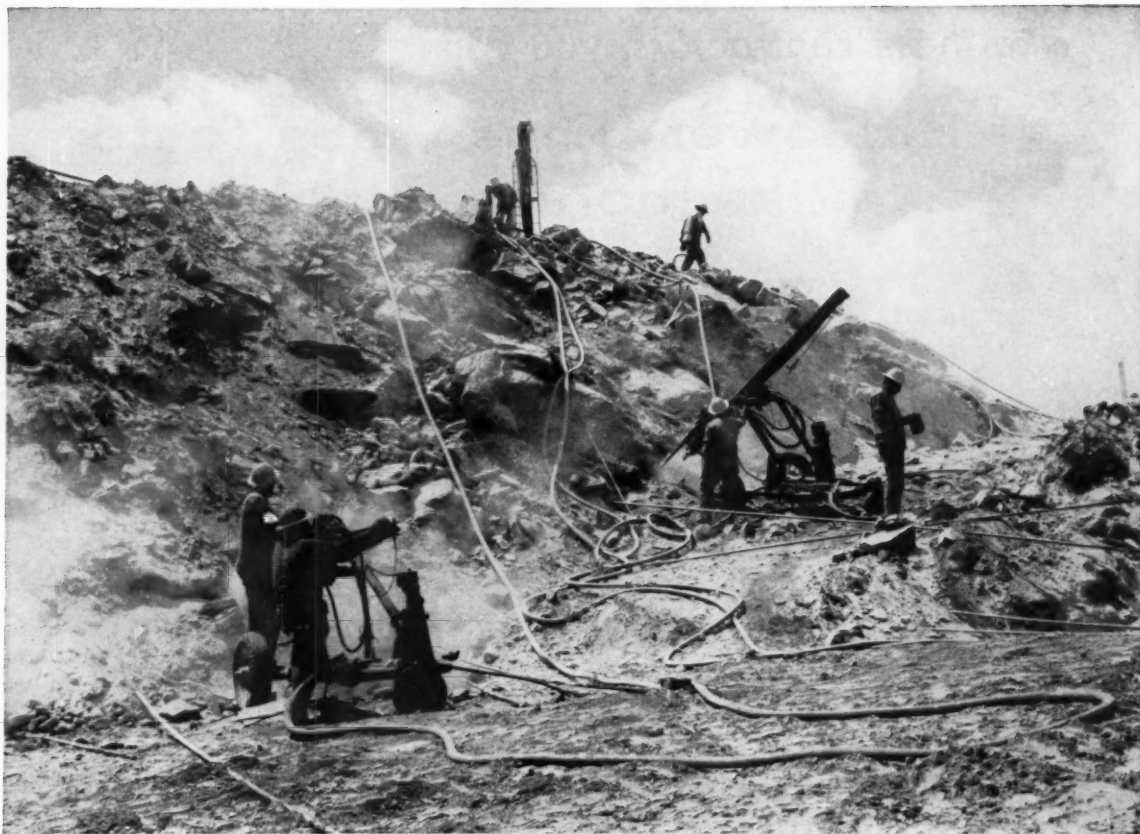
An Eimco is always your most economical loading machine. Write for details.

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B-154



Air hose with tube and cover of NEOPRENE takes rugged treatment in dam construction

In a few days air hose at a dam site takes a beating equal to a lifetime of ordinary service. There's no protection from the blazing sun, and jagged rocks tear at the cover as the hose is twisted and yanked from place to place. Inside the hose, hot oil from the compressors attacks the tube. But there is a type of air hose that will stand up to this punishment and come back for more. It's hose made with Du Pont neoprene *inside and out*.

The sturdy tube of neoprene won't go to pieces when exposed to hot lubricating oil in the air stream. No particles crumble off to travel along and clog vital tool parts. Neoprene's toughness and flexibility assure

long, trouble-free service under the toughest conditions.

The tough cover of neoprene resists abrasion, cutting and chipping throughout its long service life. And neoprene stays smooth and firm despite constant exposure to sunlight, heat and weathering . . . gives the fabric maximum protection.

Many air-hose manufacturers use Du Pont neoprene in their top-quality lines. Your supplier will be glad to show you how hose with tube and cover of neoprene is built for rugged service. Ask him about neoprene the next time you buy.

FREE! THE NEOPRENE NOTEBOOK

Each issue brings you new, unusual applications of neoprene . . . new products . . . interesting articles. Send in this coupon to E. I. du Pont de Nemours & Co. (Inc.) Elastomers Division, CA-8 Wilmington 98, Delaware.

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NEOPRENE

The rubber made by Du Pont since 1932



BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

Like these contractors, you can

**Bid lower- Finish jobs faster-
make more per contract**

SPECIFY

**GENERAL MOTORS
DIESEL POWER**

In all your construction equipment

***"Works faster... burns less fuel...
costs less to maintain."***

That's what these contractors—operating *seven* different kinds of General Motors Diesel-powered equipment—report about their GM Diesels. They've got on-the-job proof that a GM 2-cycle Diesel does more work at less cost on every construction job.

If your business is building anything from sewers to skyscrapers, you'll find a good way to build your business is to *specify* a GM Diesel when you buy equipment.

For this quick-acting 2-cycle Diesel accelerates faster under load, burns fewer gallons of low-cost fuel, stands up better even in toughest working conditions. You won't need service often but, when you do, your GM Diesel distributor backs up engine performance with fast service and quick delivery of low-cost parts, no matter where your contracts take you.

Today you can get GM Diesel power in over 750 different models of equipment built by more than 150 different manufacturers. Get their names from your local GM Diesel distributor or write direct for the list.



**25% MORE WORK AT HALF
THE FUEL COST**

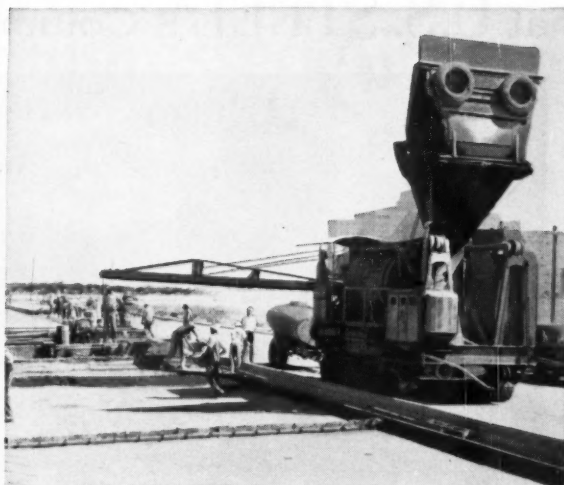
California contractors McGuire & Hester report they're getting 25% more work—and spending 50% less for fuel—since they converted this $\frac{3}{4}$ -yard dragline from gasoline to General Motors Diesel power. The compact "4-71" GM Diesel did such a good job that the contractor repowered two more shovels with GM Diesel.





WORKS $\frac{1}{3}$ FASTER—CUT FUEL COSTS 60%

Maryland contractor Charles F. Knox, Jr., reports he gets $\frac{1}{3}$ more production, has cut fuel costs 60%, since he converted this $\frac{3}{4}$ -yard shovel from *gasoline* to *GM Diesel* power. The shovel works 8 to 10 hours a day, costs far less to maintain. You can specify GM Diesel power in over 50 shovel models built by more than 20 manufacturers.



PAVES 1400 FEET A DAY

This Koehring Paver, powered by a compact, quick-accelerating GM 2-cycle Diesel, lays 1400 feet of 25-foot wide pavement per day for the Austin Road Company of Dallas, Texas. You can lay pavement faster and at less cost with GM Diesel power—available as original equipment in 8 paver models made by 4 different manufacturers.



"FASTEST DITCHER IN THE AREA"

McGuire & Hester *specified* GM Diesel power in two new Buckeye Ditchers and a Lorain Crane, as well as repowering a Hough Payloader, after getting *more work at less cost* with GM Diesel power in their dragline. The master mechanic calls this GM Diesel-powered Buckeye Ditcher "fastest in the area."



NO REPAIRS IN TWO YEARS

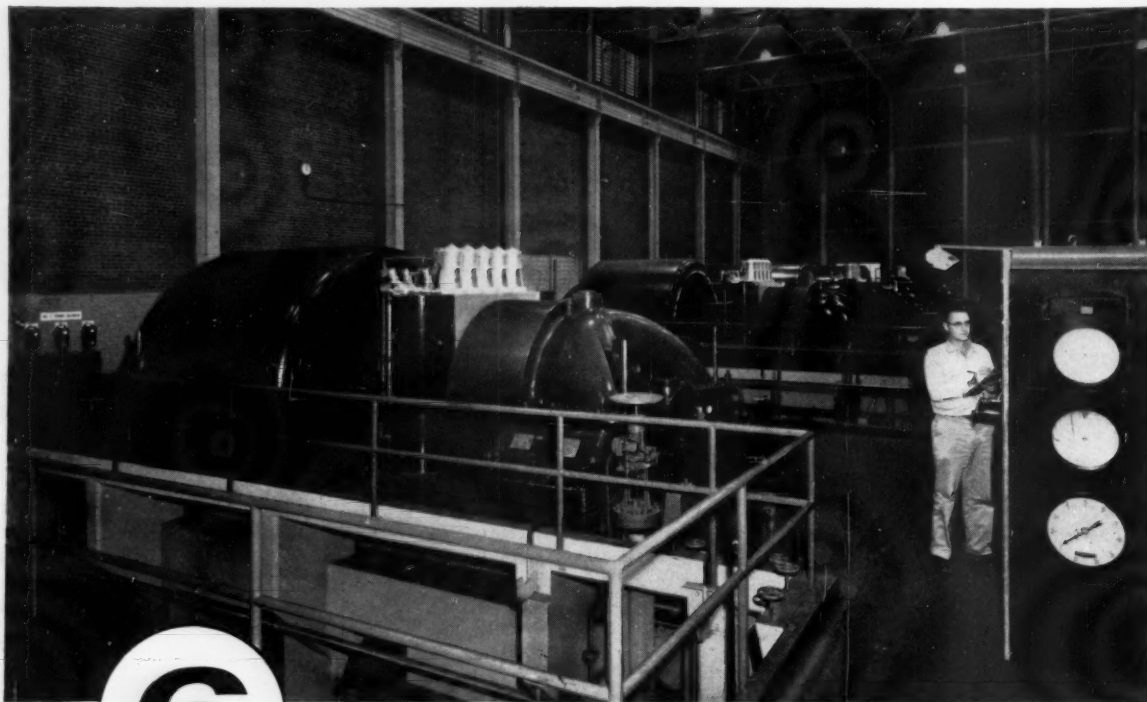
These GM Diesel-powered LeTourneau-Westinghouse Tournapulls worked over two years in flying abrasive dust without losing a day for repairs, reports Arizona contractor Link L. Colvin. In every kind of earth-moving equipment GM Diesel power lasts longer, works faster, costs less to run and maintain.

DETROIT DIESEL ENGINE DIVISION

GENERAL MOTORS • DETROIT 28, MICHIGAN

Single Engines . . . 30 to 300 H.P. • Multiple Units . . . Up to 893 H.P.

at U.S. STEEL's Columbia-Geneva Steel Division



6

I-R TURBO-BLOWERS supply BLAST FURNACE WIND

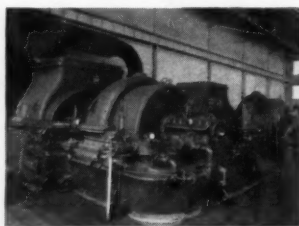
The photo above shows the blowing room at the Geneva Works of U.S. Steel's Columbia-Geneva Steel Division in Utah. Here, four Ingersoll-Rand Turbo-Blowers, each rated 95,000 cfm, 35 psig, supply wind for the blast furnaces at this large, modern steel mill. These four identical blowers, installed in 1943, are driven by I-R steam turbines, each served by an I-R surface condenser.

A thoroughly dependable air supply is of vital impor-

tance to assure continuous operation of the blast furnaces. The performance of these units, over the past 12 years, has therefore contributed materially to uninterrupted production at this

important western plant.

For year - after - year dependability, it pays to specify Ingersoll-Rand Turbo-Blowers and accessory equipment.



32 YEARS' SERVICE AT IRONTON WORKS

Here, a few miles from the Geneva Works, are two more I-R Turbo-Blowers that are still in successful operation after 32 years of service. Installed in 1923, they were originally rated 42,000 cfm at 25 psig, but the interiors were later rebuilt to increase the rating to 46,000 cfm at 28 psig. Both units are driven by I-R steam turbines, served by a common I-R barometric condenser.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.



12-277

COMPRESSORS • AIR TOOLS • OIL AND GAS ENGINES • CONDENSERS • CENTRIFUGAL PUMPS

ON THE COVER

THE man on our cover is standing on a little more than ceremony. And, like the fellow on the flying trapeze, he does so with the greatest of ease — plus a few streams of compressed air. Actually, he's standing on a short board to which air jets are attached. Compressed air, supplied to the jets by the hose that arches up to the man's feet, pushes downward with enough force to hold him up. He can even travel by leaning in the direction in which he desires to go. A parachute harness and cable were attached to him for safety during the experiment.

The same sort of push propels rockets and is now also being used to permit planes to take off and land vertically. The picture was taken at Langley Field, Va., during simplified demonstrations of several types of such devices under study by the National Advisory Committee for Aeronautics.

IN THIS ISSUE

IN 1846, William Russell Grace, a 22-year-old Irish immigrant, arrived in Peru with his father and within a few years had launched a business of his own, shipping nitrate fertilizer. The operation grew into the ramified "House of Grace," an international organization with assets of \$375 million. Its activities in the fertilizer industry are now conducted by a subsidiary, Grace Chemical Company. The latest venture is a \$20-million synthetic ammonia and urea plant near Memphis, Tenn., that uses more than 20,000 hp of high-pressure compressors. Our leading article gives the details.

GREEK mythology tells us that Pan, god of forests and wild life, changed Syrinx, an Arcadian nymph, into a tuft of reeds which he then used to fashion the Pipes of Pan. From these pipes, centuries of evolution have given us the modern pipe organ, a majestic wind instrument that is now experiencing a major comeback. Page 297.

A LONG standing plan to develop the water resources of the Willamette Valley in Oregon was brought one step nearer completion in recent months with the placing in service of Lookout Point Dam, a flood-control and power-producing structure on the middle fork of the river. It was under construction for four years. Page 302.

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EDITORIAL CONTENTS

Synthetic Ammonia Giant—C. H. Vivian	288
The Pipe Organ—Jane S. Muller	297
Lookout Point Dam in Oregon—Allen S. Park	302
Air Starting Profits Trucking Firm	304
Denver Claims Record Excavation	307
Editorials—Time and Tide—Joe College, 1955	308
Mobile Concrete Batching Plant	309
Safety Handle Saves the Knuckles	309
Long Tunnel Lined with Plastic	309
Air-Controlled Machine Automatically Feeds Forge	310
Diminutive Switcher	310
Industrial Notes	311
Quotes from Here and There	316
Industrial Books, Films and Literature	317

ADVERTISING CONTENTS

Adams Co., Inc., R. P.	38	Hercules Powder Company	32
Allis Co., The Louis	34	Hills-McCanna Company	35
American Air Filter Co., Inc.	33	Ingersoll-Rand Company	6, 18, 37, 3rd Cover
American Blower Corporation	41	International Nickel Co., Inc.	27
American Brass Company, The	8	Lehigh, Inc.	22
Armstrong Machine Works	38	Madison-Kipp Corporation	39
Bearium Metals Corp.	19	Naylor Pipe Company	25
Bethlehem Steel Company	5	New Jersey Meter Company	35
Bucyrus-Erie Company	10	New York & New Jersey Lubricant Co.	21
Celanese Corporation of America	4	Niagara Blower Company	26
Compressed Air Magazine Co.	35	Norgren Co., C. A.	36
Continental Motors Corporation	30	Norton Company	11
Coppus Engineering Corp.	9	Punch-Lok Company	36
Crucible Steel Co. of America	31	Sauerman Bros., Inc.	20
Detroit Diesel Division—General Motors	16, 17	Schraders' Sons, A.	42
Diehl Manufacturing Company	13	Texas Company	2nd Cover
Dixon Valve & Coupling Co.	23	Timken Roller Bearing Co.	Back Cover
Dollinger Corporation	3	United States Rubber Co.	29
du Pont de Nemours & Co., E. I.	15	Walworth Company	12
Eimco Corporation, The	14	Westinghouse Electric Corp.	7
France Packing Company	28	Wood's Sons Co., T. B.	38
Garlock Packing Company, The	24		
General Electric Company	43		
Grinnell Company, Inc.	40		

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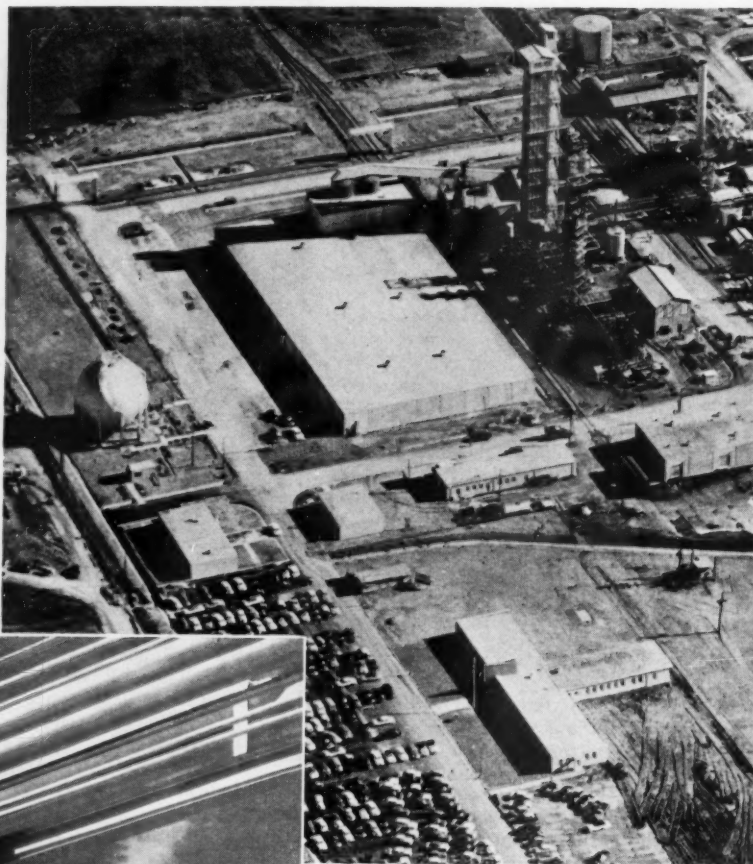
COMPRESSED AIR MAGAZINE is on file in many libraries and is indexed in Industrial Arts Index and in Engineering Index.

NITROGEN FROM THE AIR

SYNTHETIC AMMONIA GIANT

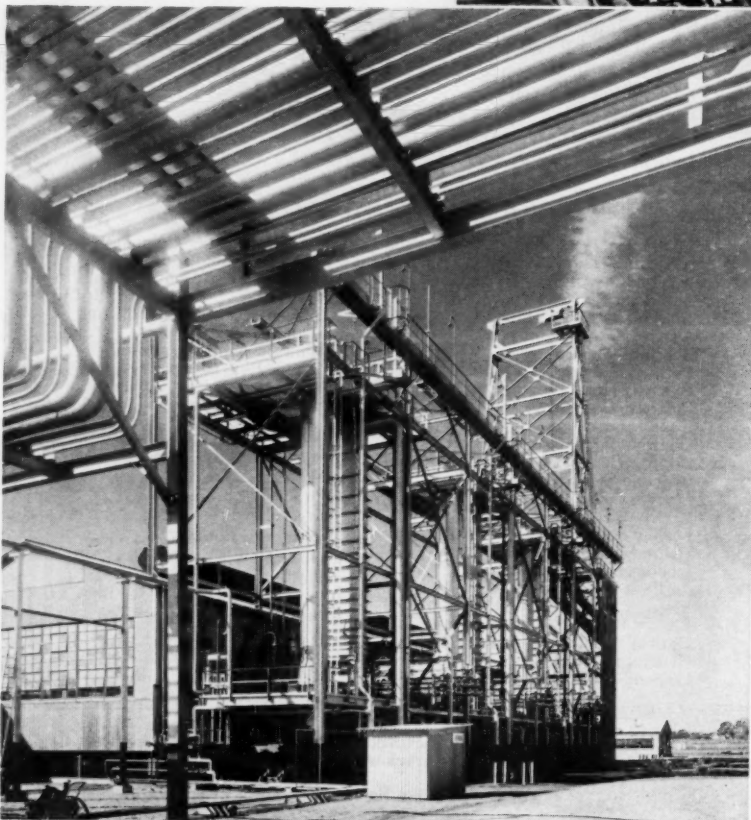
Grace Chemical Company's
\$20-million Plant in Tennessee
Utilizes Large Compressors

C. H. VIVIAN



AERIAL VIEW

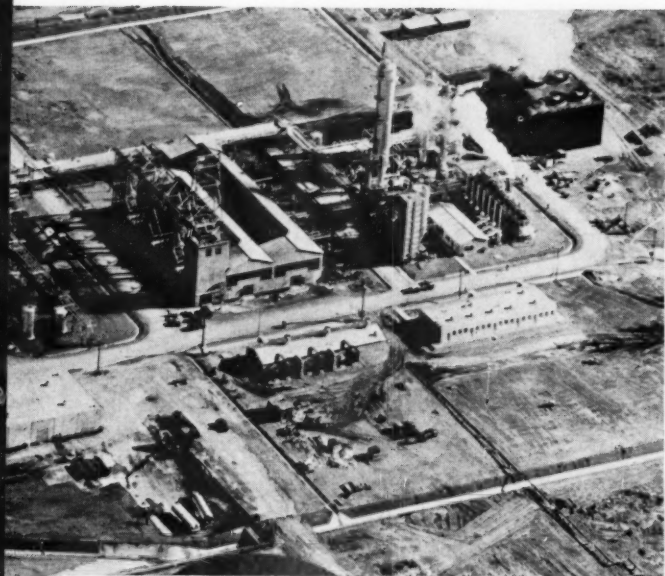
One of the largest of its kind, this plant can produce 250 tons of anhydrous ammonia per day and convert 100 tons of it into 150 tons of urea. Pellets of urea from 4 to 30 mesh in size are sold for livestock feed. A purer form, marketed as crystals, enters into numerous industrial products. In the picture, the sphere at the far left is for storing anhydrous ammonia. On its right is the warehouse, needed chiefly for storing urea. Next to it is the urea prilling tower, a 20-story structure within which pellets are formed by spraying liquid urea into a rising column of air. Farther to the right is the ammonia processing section, with the water cooling tower at the far right. The T-shaped building directly above is the office. Above it, left to right in line with the street, are the laboratory and machine and service shops.



CASALE CONVERTERS

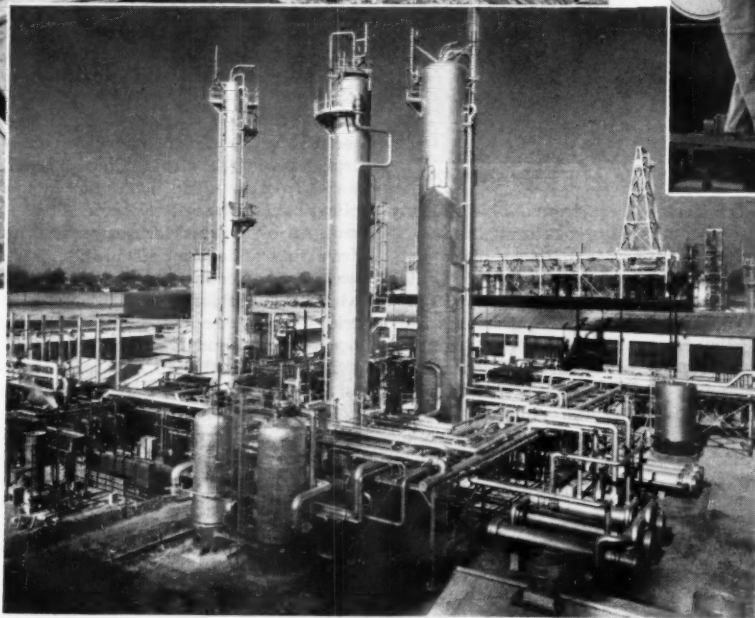
Framed by overhead piping that runs to the urea section are three slender cylinders within which the actual synthesis of ammonia takes place when the properly proportioned gas mixture at 9000-12,000 psi pressure is passed over an iron-base catalyst. As it flows through myriads of small tubes, the converted gas is cooled by surrounding water and condensed to a liquid. The converters, instead of being forged, were fabricated in the A.O. Smith Corporation shop by welding together multiple layers of steel.

NITROGEN is the earth's most abundant element. It makes up 78 percent of our atmosphere, by volume, and there is about 35,000 tons of it above every square mile of the globe's surface. In its native gaseous state, mankind can use it for little else except breathing, but when combined with one or more other elements, or "fixed," as the chemist says, it can fertilize the soil, enrich livestock feed and enter into numerous essential products



FIRST PRODUCTION

John G. Carriere, plant manager, gives the signal for filling the first tank car of anhydrous ammonia produced at the new plant on December 21, 1954. With him is C.U. Ellis, superintendent of the plant-food division of Swift & Company, which bought the ammonia.



PIPES AND TOWERS

Outwardly, much of the \$20-million plant appears to the uninitiated as a jungle of piping, studded here and there with cylindrical vessels and tall towers. Nevertheless, through this maze, the fascinating legerdemain of chemistry leads three common substances—air, natural gas and water, tears them apart molecularly and reassembles the component gases into useful ammonia and urea. In the foreground are the "shift" converters and hydrogen purification towers. Behind the walls of the building are powerful, pulsing compressors that apply an essential squeezing action at various stages. Process pressures range from 3 millimeters of mercury to 12,000 psi; temperatures from minus 300° to 2000°F. To meet these varied conditions, alloys of steel and other metals are generously used in the equipment.

ranging from toothpaste to television cabinets. It is an indispensable constituent of plant and animal tissues, the main stimulus of leaf growth and the source of chlorophyll, the green coloring matter of plants. Animals, including man, obtain nitrogen by eating other

animals and vegetation, and their bodily chemical processes combine it with oxygen and hydrogen to form essential protein.

Most plants procure their nitrogen from water-soluble soil compounds such as nitrates and nitrides, which are creat-

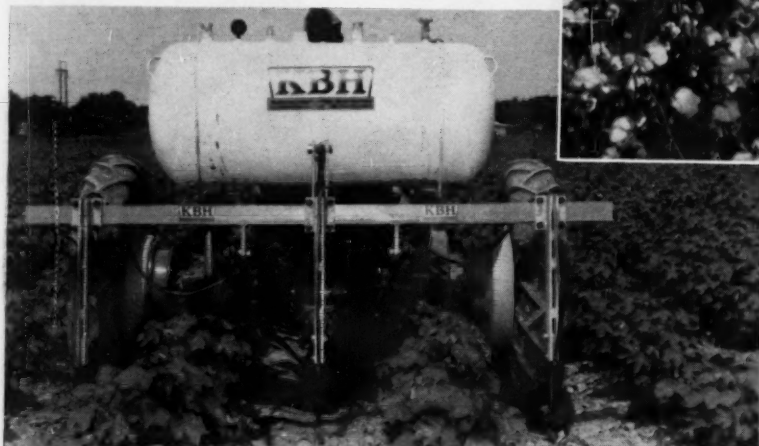
ed underground from atmospheric nitrogen by certain bacteria. As an intermediate bacteriological step nitrogen is combined with hydrogen to form ammonia. A few plants, the legumes—which include beans, peas and clover—harbor these bacteria in tiny nodules on their roots and can, consequently, assimilate nitrogen directly from the air. All others must rely on the work of external bacteria, or on help from man in the form of fertilizer.

As nitrogen is not found far below the ground surface, it is believed that all of that element now there in combined or fixed form was originally in the atmosphere. Electrical discharges in the sky cause nitrogen to unite with oxygen, and the resulting oxides are brought down with rain, the addition of water forming nitrous and nitric acids. In this way, we are told, an average of 250,000 tons of nitrogen reaches the earth's surface every 24 hours, but much of it falls on oceans and mountains.

Nitrogen is also returned to the earth by animal wastes and decaying animal and vegetable matter. On untilled land, where grass and weeds wither annually and leaves fall and remain on the ground, the balance of nitrogen is maintained well enough to support forests and other natural growths. However, where the land is cultivated and crops are harvested annually all except the legumes exhaust nitrogen and other plant foods

BONUS FROM AMMONIA

Ammonia, which contains 82 percent of the essential plant food nitrogen, can be applied to the soil either by direct injection, as illustrated here, or by adding it to irrigating water. Underground, the liquid ammonia changes to gas that is immediately absorbed. Up to 150 acres can be covered in a 10-hour day with injection equipment. The other picture shows the cotton field that won for Willie Frank Waterer (left), a 4-H club member, the title of Mississippi's cotton king for 1953. He applied 120 pounds of nitrogen in the form of ammonia to his 5-acre plot and raised three bales per acre. Half that yield is considered good if no nitrogen is used. The man at the right is George Rone, associate county agent.



AGRICULTURAL AMMONIA NEWS



rapidly, and unless these substances are replaced the yield will soon diminish.

This need of restoring nitrogen to the soil has been known for centuries, but until comparatively recently man-placed fertilizers were limited to organic materials such as manure, wool, fish scrap, cottonseed meal, bones and blood. During the first half of the nineteenth century, chemists and botanists began probing the mysteries of plant growth and learned that the three most needed stimulants were nitrogen, phosphorus and potassium. All these occur rather sparingly in natural mineral deposits, and the first of them to be discovered and put to use commercially was saltpeter (potassium nitrate) from India. With the invention of black powder, which requires this chemical, the Indian deposits grew in importance. In 1830 extensive beds of sodium nitrate, locally called *caliche*, were found in Chile and soon supplanted the Indian material as a source of nitrogen.

The first factory to turn out commercial mixed fertilizer containing these natural inorganic substances was established at Rothamsted, England, by B. J. Lawes in 1843. Others soon followed, and their output increased crop production and helped Europe in general and England in particular to support rapidly growing populations. For several decades Chile was almost the sole source of nitrates, although towards the close of the century some nitrogen in the form of ammonia (about 4-5 pounds per ton of

coal treated) became available as a by-product of making coke, and plants manufacturing gas began to supply ammonium sulphate. Incidentally, the United States now gets approximately 10 percent of its ammonia requirements from coke ovens.

In 1898, Sir William Crookes made the startling prediction before the British Association for the Advancement of Science that the world would face the threat of starvation when the Chile nitrate deposits were exhausted. Actually, the beds would have sufficed for another 100 years or more, but the cost of the material delivered in England was \$35 per ton because of a substantial tax levied by the Chilean government and appreciable transportation charges. At the same time Sir William hinted that, with low-cost electrical energy such as could be produced at Niagara Falls, nitrogen from the atmosphere might be fixed.

His remarks naturally intensified the long-standing search of scientists for a way to combine nitrogen with other elements into a stable usable form. The first adequate process was developed in 1895 by two young Germans, Doctors Frank and Caro, who discovered that they could produce a compound containing 18-20 percent nitrogen by passing air over a white-hot mass of calcium carbide. This dark-gray odorless, dustless, water-soluble substance called cyanamid was found to be valuable as a fertilizer, and factories to make it sprang

up all over the world. One was located at Niagara Falls, N.Y., in 1909. During World War I our Government built the largest existing cyanamid plant at Muscle Shoals, Ala., using hydroelectric power generated there by the Tennessee River. Known as U.S. Nitrate Plant No. 2, it ran for only two months and has remained idle.

The cyanamid process was slightly antedated by the arc process by which nitrogen from the air is combined with water to make nitric acid, thereby duplicating Nature's handiwork. The Atmospheric Products Company erected an arc plant at Niagara Falls in 1902, but it was closed after two years. The method, which requires large quantities of electricity, was later successfully exploited by Birkeland and Eyde in Norway.

In 1907, Fritz Haber, a German chemist, discovered that if one part nitrogen and three parts hydrogen are brought together under certain favorable conditions they will combine to form ammonia. At ordinary temperatures and pressures the two gases will associate for years without much change, but if they are compressed and heated and then passed over a suitable catalyst they will unite readily. Haber's work became the basis for the Haber-Bosch process for synthesizing ammonia and provided German military forces during World War I with nitrates for the manufacture of explosives when their nation was cut off from Chile's natural deposits by the Allied blockade. Our own Government later built a plant on the Tennessee River in Alabama as a war measure but made little use of it.

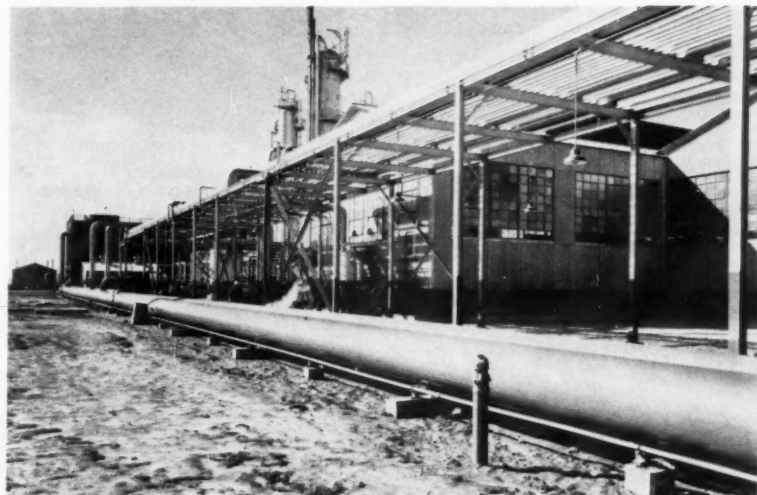
The Haber-Bosch process soon demonstrated its superiority over the previous "fixation" schemes and was adopted in preference to them. In its case, the synthesis takes place at about 1000°F and 3000 psi pressure. The nitrogen and hydrogen were obtained in Germany from producer gas (nitrogen content 50-65 percent) and water gas (hydrogen content 52 percent) both of which were

made by blowing first air and then steam through a coke fire.

Since the initial Haber-Bosch plant began to operate in 1913 many variations of the method have been introduced, but the original principles have been substantially retained. In all current processes there are three main steps: obtaining the nitrogen and hydrogen for the synthesis gas, purifying the gases and reacting the relatively pure combined gases to form ammonia. Most of the modifications concern differences in the sources of the nitrogen and hydrogen, in temperature and pressure conditions of the ammonia synthesis, in catalysts used, in design of the ammonia converter and in methods of product recovery. Well known among the varied designs is the French Claude or *Air Liquide* process. This, in turn, was modified by L. Casale, and it is the Casale process with which we are concerned here.

Ammonia is a highly satisfactory form of fixed nitrogen for most purposes. As its nitrogen content (82.25 percent) is the highest of any of the compounds, it is well suited for fertilization and can be injected into the ground in liquid form or dissolved in water and applied during irrigation. Ammonia can also be easily converted into other nitrogenous compounds if that is desired. One of them is urea.

A relatively new commercial plant food, urea is a crystalline, odorless substance that contains one-third more nitrogen (45 percent) than any other solid commercially marketed material. As it is soluble in water, it may be applied directly to crops either as a solid or a liquid. Plant leaves readily assimilate the solution, and it is often included in



WATER SUPPLY

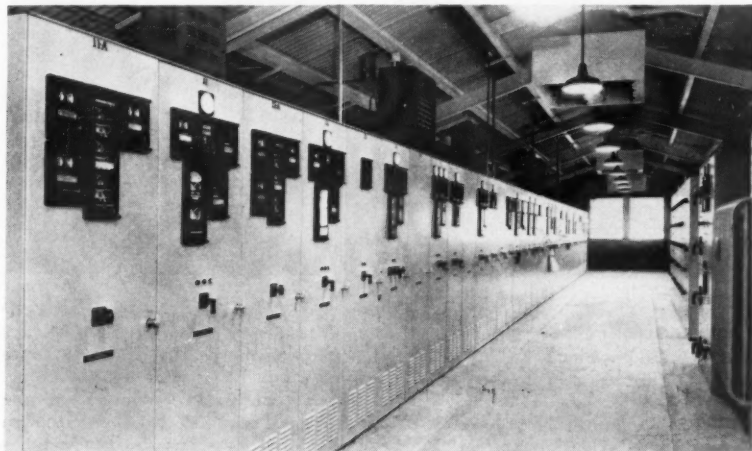
Heat units are juggled expertly in the plant. For example, cold gases coming from the liquid-air fractionation plant cool incoming air and are themselves warmed in exchange. In addition, large quantities of water are utilized to absorb the heat of compression, the heat generated by the ammonia synthesis in the Casale units and for other purposes. This water is pumped from two 500-foot wells on the property and used over and over by cooling it during each circuit in a Fluor 3-cell redwood tower having a capacity of 28,000 gpm. Slanting upward from right to left in this picture are two 36-inch-diameter pipe lines that carry water to and from the cooling tower in the distance. On the right of the mains is the compressor building.

insecticide and fungicide sprays. Ruminant animals are biologically equipped to digest urea, and when mixed with other feed it will give cattle, sheep and goats up to one-third of their protein requirement. Used as a supplement to grass and grain, it will, it is claimed, produce choice beef at a lower cost than any other protein additive.

Industrially, urea enters into the manufacture of plastics, adhesives and drug and toilet articles. It is found in households in the enamel finishes of stoves and refrigerators, resin glues for furniture and plywood articles, ammoniated toothpaste and textile finishes. Urea can be made, stored and shipped without explosion hazard.

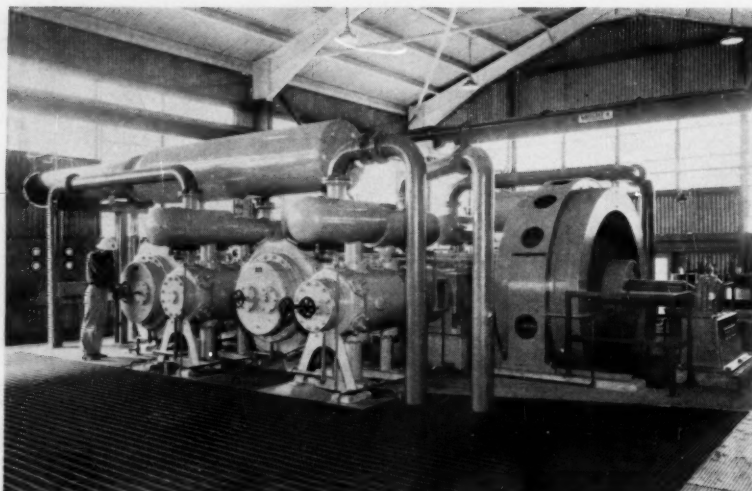
When World War II touched off a heavy demand for nitrates for munitions and for growing food for the armed forces and civilian workers, numerous synthetic-ammonia plants were built in America. The sharp postwar increase in population and the Korean emergency continued the trend. In 1950 the Defense Production Authority set a goal of nitrogen-producing capacity of 3,000,000 tons per year by 1955, with 2,185,000 tons to be earmarked for fertilizers and the remainder for industrial products. This called for new facilities large enough to manufacture 1,291,000 tons. That objective has been exceeded and there is, in fact, a small excess in capacity for the time being. Fortunately, however, surplus material can be made into solid forms and stored until it is required.

The plants now in existence can turn out 3.3 million tons annually, and others with a total output of 1.4 million tons are proposed. If all current plans are carried out and no more new facilities are scheduled in the meantime, the aggregate capacity in 1957 will be 4.7 million tons.



ELECTRICAL SWITCHGEAR

The plant contains 28,000 hp of electric motors, of which 21,000 hp is represented by six units that drive the large compressors. They are too big to be controlled by conventional equipment, and this function is handled by means of an 85-foot line of General Electric metal-clad switchgear shown here in part. The current, which is purchased, comes into the plant at 12,500 volts and is stepped down to 4160 volts for motor use.



MULTIPLE-GAS COMPRESSORS

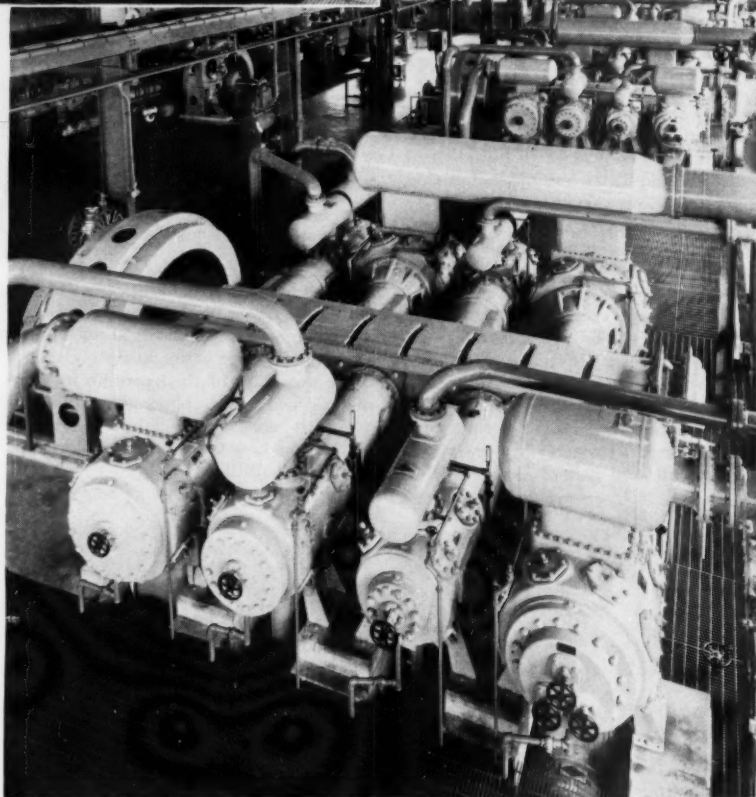
In line at the bottom are the three most powerful reciprocating process compressors ever built. These 4000-hp Ingersoll-Rand machines are additionally noteworthy because they simultaneously handle three different gases under varying intake and discharge conditions. Air is compressed from atmospheric pressure to 630 psi in four stages, nitrogen from 15.2 to 330 psi in three stages and natural gas from 58.7 to 440 psi in two stages. The arrangement of the cylinders on both sides of a central crankshaft is visible. The other picture shows a side view of one of the units, with the driving motor at the right.

A survey conducted in 1952 disclosed that around 74 percent of the ammonia made was going into fertilizers, 20 percent into industrial products and 6 percent was used for military purposes. These figures are most likely substantially correct as of now. Among industrial applications, explosives and chemicals rank even and make up more than half the consumption, the remainder being used in plastics and resins, textiles, metal treating, refrigerants, petroleum refining, pulp and paper, and for miscellaneous other purposes.

Until about 1940 virtually all synthetic ammonia was made by chemical concerns. Then, because natural gas and petroleum-refinery gases are perhaps the most suitable sources of hydrogen, oil companies began to enter the field and ammonia has become an important factor in their growing petrochemical operations. Chemical concerns now turn out about 60 percent of the total, oil companies 28 percent and miscellaneous newcomers the remainder.

Late last year Grace Chemical Company put in service near Memphis, Tenn., one of the largest ammonia plants now operating. It is capable of making 250 tons of anhydrous (liquid) ammonia daily and converting 100 tons of it into 150 tons of urea. In terms of nitrogen, this amounts to approximately 73,000 tons annually. Ground was broken on October 14, 1952, the first ammonia was shipped in December 1954, and the plant was dedicated on January 6, 1955. A bronze plaque in the main entrance hall proclaims that it is "dedicated to the welfare and prosperity of Memphis and the Mid-South." Memphis was selected as the location because it is the center of a vast agricultural area that can use much of the product and because it met all the requirements for raw material, labor, etc.

Foster Wheeler Corporation, of New



York, which has built or is building facilities having a combined capacity of more than 300,000 tons of ammonia per year, designed and constructed the plant which utilizes three main basic processes: the Texaco partial-oxidation method of producing hydrogen, the Casale ammonia-synthesis process and the Pechiney process for making urea. Though the Grace plant is only the fourth one in America to employ the Foster Wheeler-Casale method, the latter is applied throughout the world in more than 40 plants with an

aggregate capacity exceeding 5000 tons of ammonia daily. The Pechiney process is likewise a newcomer in this country, and only the Grace Company and one other concern are using it here, although considerable satisfactory experience has been had with it abroad.

In the Grace plant, air is filtered and compressed to 600 psi pressure in four stages. It is "scrubbed" with a caustic to remove impurities and passed over an alumina desiccant to remove moisture and thus avoid a freeze-up in the subse-

quent liquefaction step. After preliminary cooling in a heat exchanger it enters an air-fractionation unit, built by Air Products, Inc., of Allentown, Pa., which can produce 200 tons of oxygen daily. It is claimed to be the largest high-pressure plant of its kind in existence. There the air is further cooled in heat exchangers and finally liquefied by direct expansion and work expansion in a turbogenerator rotating at about 20,000 rpm. Next, it is separated by distillation into liquid oxygen of approximately 95 percent purity and highly pure nitrogen gas. Some of the nitrogen is compressed to 300 psi, returned to the air-fractionation unit and liquefied for use later in absorbing impurities from hydrogen. The remainder of it passes through the heat exchangers of the air plant to cool incoming air and then goes to the ammonia-synthesis section.

The liquid oxygen is transferred at 400 psi pressure by means of a special centrifugal pump to the Texaco partial-oxidation step that produces hydrogen for ammonia synthesis. On the way, it, like the nitrogen, cools incoming air in heat exchangers and is thereby warmed sufficiently to vaporize.

After being further warmed with steam the oxygen is reacted with natural gas, which is about 94 percent methane, a combination of one part carbon and four parts hydrogen. The natural gas reaches the plant at around 60°F and 100-175 psi pressure. It is compressed to 400 psi, heated in direct-fired vessels

and mixed with the preheated oxygen in specially designed burners. By carefully controlling the gas-oxygen ratio, the combustion reaction, which occurs at 350 psi pressure and above 2000°F, results in the formation of hydrogen and carbon monoxide. The mixture is quenched and scrubbed with water, the latter vaporizing and taking part in the next step, which is known as shift conversion. Before entering it, the gases are reheated, more steam is added and, at approximately 300 psi and 750°F in the presence of a catalyst, the carbon monoxide absorbs additional oxygen from the steam and becomes carbon dioxide. Stripping the oxygen from the steam molecules leaves more hydrogen behind.

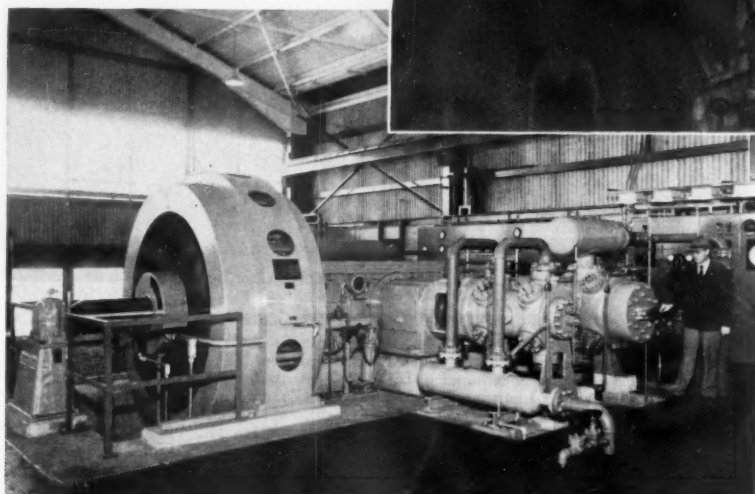
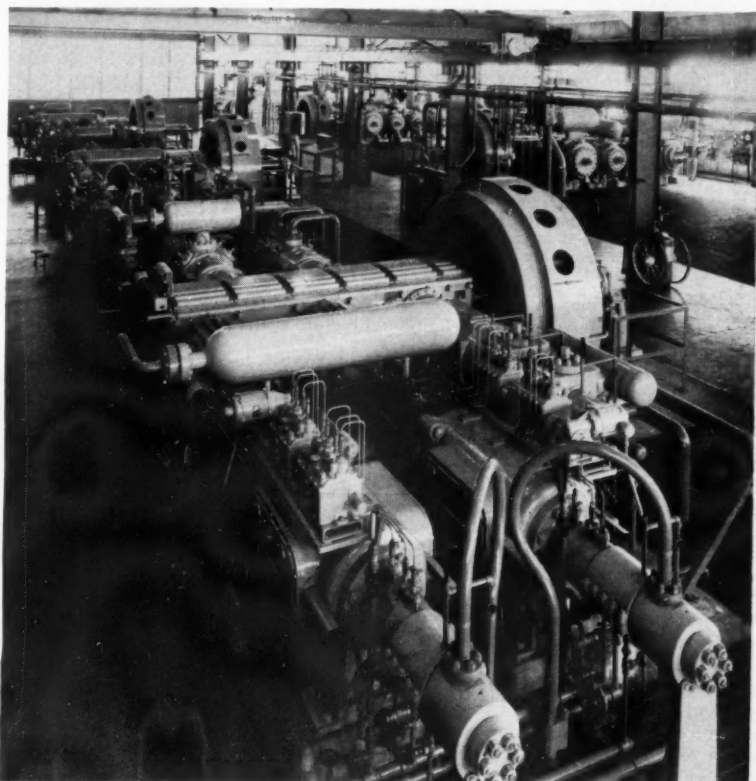
To separate the hydrogen and carbon dioxide the mixture is cooled by heat ex-

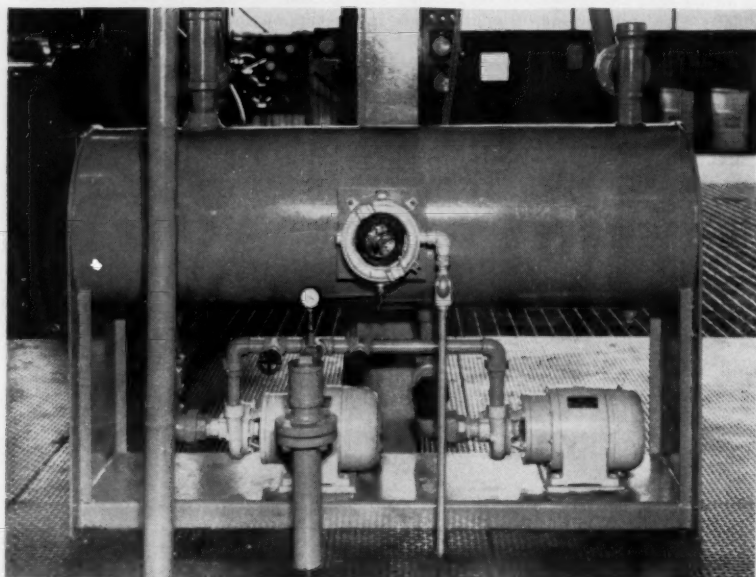
change and brought in contact with a monoethanolamine (MEA) solution in a packed column functioning at 300 psi pressure. The liquid MEA takes up substantially all the carbon dioxide, and the hydrogen passes on to be further purified for use in the ammonia synthesis. The MEA is relieved of the carbon dioxide and reactivated by heating it in a reboiler with the hot combined gases from the shift converter utilized in the previous stage.

The first step in purifying the hydrogen is to bring it in contact with a caustic solution to remove carbon dioxide and with a desiccant to extract moisture and prevent ice from forming in the next operation, during which it is scrubbed with liquid nitrogen at 275 psi pressure and -300°F. This condenses traces of

SYNTHESIS-GAS COMPRESSORS

In each of the three machines shown (right), the ammonia synthesis gas, in the proportion of three parts hydrogen to one part nitrogen, is compressed in five stages to from 9000 to 12,000 psi pressure, depending on operating conditions, and sent to the Casale units for conversion. Also pictured is a side view of one of the machines, with its 3000-hp motor at the left.





COMPRESSOR LUBRICATION SYSTEM

Lubricating oil for the bearings of six large gas compressors is circulated by a central system. From the tank shown, the two Ingersoll-Rand Motorpumps underneath it pump the oil to the individual machines, where other similar pumps distribute it to the bearings and return it to the reservoir. Cylinders of the compressors are lubricated by separate individual force-feed systems.

carbon monoxide, methane and argon so that they can be removed. The liquid nitrogen comes from the air-separation plant, as previously mentioned. That which boils off joins the stream of hydrogen.

The purified hydrogen and nitrogen gases then meet, the nitrogen coming from the air-separation plant and being first compressed to 300 psi. They are mixed in the proportion of three volumes of hydrogen to one volume of nitrogen, compressed to pressures which may go as high as 12,000 psi, cooled to around 100°F and delivered to Casale converters through the nozzles of an ejector that is a distinguishing feature of the Casale process. In the reactor some of the hydrogen and nitrogen unite in the presence of an iron catalyst to form ammonia. The unconverted portion is recirculated through the ejector, where it is entrained by the high-pressure fresh feed stream and carried on through for further reaction.

The ejector performs the service that normally requires a mechanical circulator. The high operating pressure in the Casale process produces ammonia at normal cooling-water temperature. It is also claimed that there is a better tolerance than in other systems for minor amounts of oxygen and carbon monoxide if present in the synthesis gas. The liquid anhydrous ammonia averages about 99.95 percent pure, and flows to a refrigerated Hortonsphere for storage.

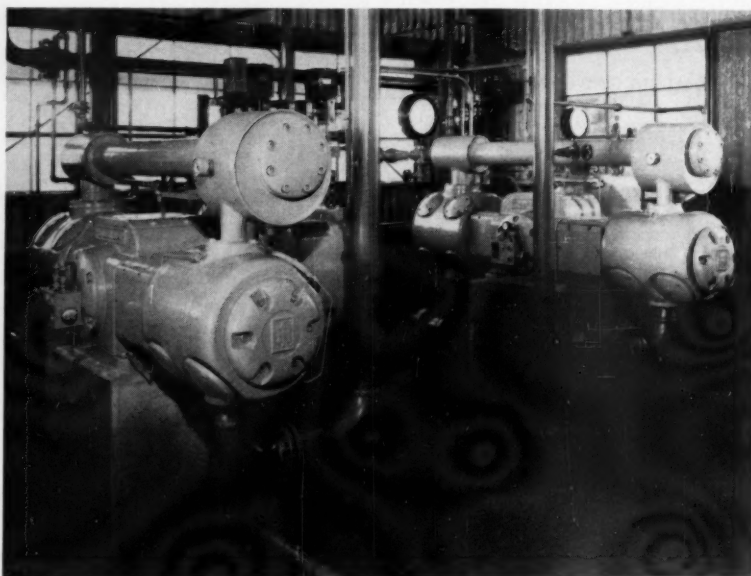
In the foregoing account it was noted, perhaps, that the various gases are

handled under pressure at every step. Pressure is, in fact, an essential of all am-

monia-synthesis processes and especially of the Casale method in which the pressure range of up to 12,000 psi is greater than in most. Compressors are, then, the heart of any ammonia plant, and those in the Grace establishment are particularly noteworthy both as to size and certain design features.

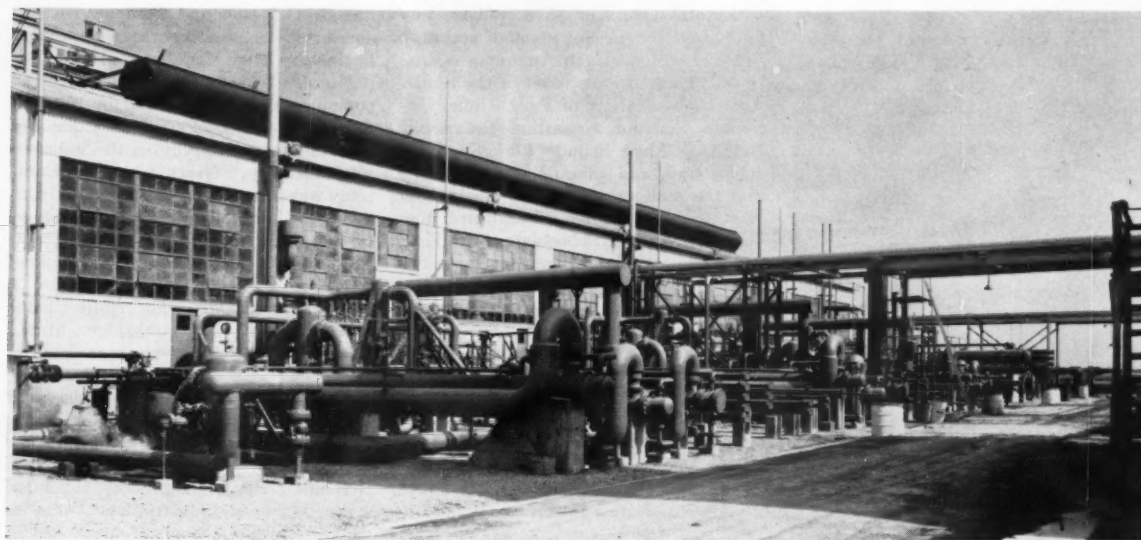
Under one roof are seven gas compressors driven by motors totaling 21,900 hp, which constitutes more than 80 percent of the plant's total connected electrical load. Three of the machines, each of 4000 hp, are among the most powerful reciprocating compressors ever built. Three others are of 3000 hp each, and the seventh unit is of 900 hp. All the machines were built by Ingersoll-Rand Company and are of the HHE type in which horizontal cylinders are on opposite sides of a centrally disposed crankshaft driven by a synchronous motor direct connected to one end. This design makes it possible to arrange cylinder combinations to meet any given set of pressure conditions.

The three 4000-hp units are of extraordinary interest because each simultaneously compresses three different gases all to different pressures, utilizing nine cylinders. Air for the separation plant is compressed from atmospheric pressure to 600 psi in four stages. (The discharge pressures given in this paragraph and the next one are maximum



PLANT AIR COMPRESSORS

One of these two Ingersoll-Rand machines supplies air at 115 psi pressure to drive maintenance tools and for general plant purposes. The other one furnishes air at 100 psi, which is reduced to 60 psi for distribution and then to 15-20 psi for use in operating instruments that automatically control most of the process work. If the latter compressor should fail, instrument air can be taken from the other unit, and if that, too, should be out of service it could be obtained from the air section of one of the three multiple-gas compressors that handle air, nitrogen and natural gas. The cost of instrumentation in the plant represents about 2 percent of the total outlay for construction and approximately 8.7 percent of the expenditure for processing equipment.



EQUIPMENT FOR COOLING

All this equipment—intercoolers, aftercoolers and separators—serves gas compressors and two ammonia refrigeration compressors located in the structure at the left. In a colder climate it would be indoors, but moderate Memphis winters make this unnecessary. So the building

was constructed without a basement and at a saving in cost. Each compressor sits on a sizable block of concrete extending underground to a firm footing, but elsewhere beneath the floor is about 5 feet of space for piping between the machines and the outdoor cooling equipment.

operating pressures and vary somewhat from the average operating pressures which were given previously. All pressures are absolute.)

Nitrogen that is liquefied for use in purifying hydrogen and also all the nitrogen feed for the synthesis-gas combination is compressed from 15.2 psi to 330 psi in three stages. Natural gas for the partial-oxidation process is compressed from 58.7 psi to 440 psi in two stages. Each unit is therefore essentially three compressors in one. This naturally saves space and capital investment, but it can be appreciated that the designing engineers had to solve some knotty problems in order to attain well balanced and smoothly running machines that would satisfy the multiple requirements.

The 3000-hp units were designed to compress the ammonia-synthesis gas, composed of one part nitrogen and three parts hydrogen, from 275 psi to 12,100 psi in five stages. The 900-hp machine compresses carbon dioxide for the urea process from 19.7 psi to 3215 psi in four stages.

The HHE is the result of Ingersoll-Rand's 40 years of experience in the high-pressure field. The company began supplying compressors for ammonia synthesis in 1926. The first three units are still running. In the intervening 29 years it has furnished machines, solely for handling synthesis gas, totaling 225,000 hp and designed for discharge pressures that range from 2000 to 15,000 psi.

We have mentioned that there are three multiple-gas compressors and three synthesis-gas compressors. There are

likewise three Casale reactors. Each combination of two compressors and one reactor constitutes a unit or production line that the industry calls a "train." The plant thus has three trains, each with a daily capacity of 83½ tons of ammonia. If one synthesis-gas compressor is out of commission for repairs or inspection the two others can maintain production in all of the reactors at a slightly reduced rate.

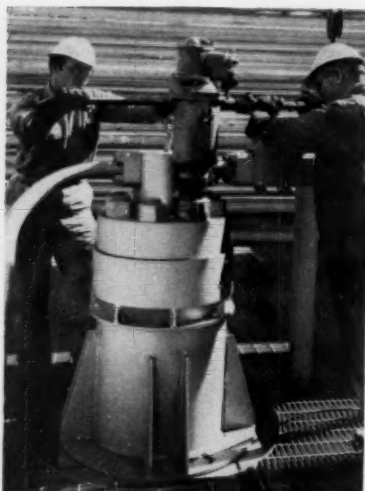
Urea is made by combining ammonia with the carbon dioxide that is recovered from the synthesis-gas absorption system, the reaction taking place at 3000 psi pressure and 350°F. First an intermediate product, ammonium carbamate, is formed. About 60 percent of this salt or ester of carbamic acid then turns into urea, and water is obtained as a by-product. When the pressure is reduced to about 80 psi, the unconverted carbamate decomposes into ammonia and carbon dioxide.

The mixture is next brought in contact with mineral oil in a horizontal vessel known as a salt-oil reactor. The gases then recombine to form carbamate, which is dispersed as a finely divided solid throughout the oil. The resultant slurry is returned to the reactor along with the feed of fresh ammonia and carbon dioxide and some of it is converted to urea. Recycling eventually converts all of it. In addition to serving as a vehicle for the unconverted carbamate, the oil coats the walls of the reactor and lessens metallic contamination caused by corrosion. It also absorbs heat in the reactor and carries it outside, where it is removed as the slurry is recycled.

Urea that is destined for use as a fertilizer either alone or in mixtures, or as a feed for livestock, is reduced to a molten state by evaporation and prilled in a tower about 200 feet in height. The liquid is sprayed in at the top and descends against a rising current of air in drops, which are solidified by the time they reach the bottom. After being coated with clay to prevent them from sticking together they are bagged and weighed. Urea intended for industrial use is further purified by removing all traces of iron and other unwanted substances by adsorption or chemical treatment. It is then crystallized by vacuum evaporation, centrifuged, dried in a rotary kiln and bagged.

Grace Chemical Company is a subsidiary of W. R. Grace & Co., an international corporation of diversified interests which celebrated its hundredth anniversary last year. The present concern was founded by W. R. Grace, who migrated to Peru with his father from Ireland in 1846 following a potato famine in their homeland.

In the port of Callao, where he worked for a ship chandler, he saw the possibilities of profit in exploiting the natural guano nitrate deposits of the Chincha Islands off the coast of Peru. He shipped this fertilizer and, later, *caliche* from Chile to the United States in chartered vessels. That was the beginning of an extensive trading business between the Americas and of the development of diversified manufacturing enterprises in South America that have made the name of Grace well known above and below the equator.



POWERFUL WRENCH

High-pressure vessels in the plant are held together by king-size bolts. This heavy-duty air-operated I-R Impactool is indispensable for dislodging nuts and then running them back on tight after equipment has undergone inspection or overhaul. As shown, the tool is working on a $4\frac{1}{2}$ -inch hexagonal nut on a 3-inch bolt. Additional sockets enable it to handle nuts up to $7\frac{1}{4}$ inches across.

Mr. Grace moved to New York in 1865, became an American citizen and opened offices near Hanover Square, close to the present headquarters. He was twice (1880 and 1884) elected mayor of the city. His grandson, J. Peter Grace, is now president of the company, which,

with total assets of \$375 million, has four basic divisions or areas of activity:

Number 1 is South American operations. These are centered in the South American countries of Peru, Chile, Colombia, Ecuador, Argentina, Brazil and Bolivia. They include the growth of sugar cane and manufacture of sugar and the making and sale of paper, textiles, paint, vegetable oil and lard, biscuits, candy and chocolate. In Peru alone the ramified operations have tripled in the past ten years and now give employment to 12,000 persons. In Bolivia, Grace mines tin and tungsten and runs a cement plant. Pan-American-Grace Airways (Panagra), South America's principal air line, is 50 percent Grace owned.

Activity Number 2 is shipping. The Grace Line was started to serve Grace interests on the west coast of South America and grew into a major passenger- and freight-carrying system that features the luxurious "Santa" ships. Grace vessels pass through the Panama Canal on an average of sixteen times a month. They made 275 complete voyages in 1954. Grace Line's new Pier 57 on the Hudson River in New York City is called the most modern structure of its kind.

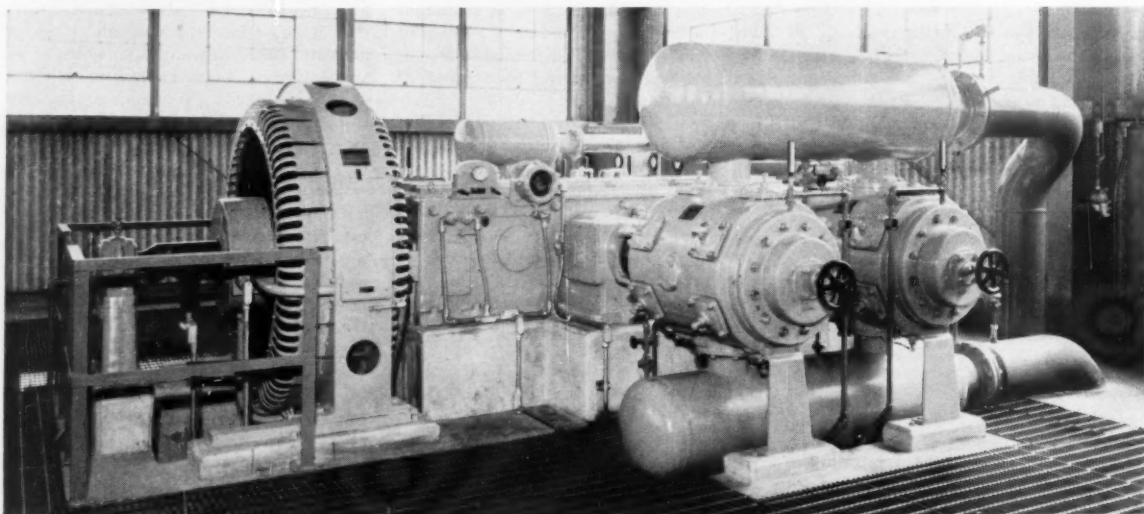
Division Number 3 is general business operations in the United States. Heading the list is the Grace National Bank of New York. The Grace-owned Foster and Kleiser Company, which operates on the Pacific Coast, is the nation's second largest outdoor advertising agency. It owns 32,000 billboards and other display structures. Other Grace businesses

include Griswold and Company, which conducts a general insurance brokerage business in New York.

Number 4 is chemicals. Although the company entered this field in 1907 by organizing Naco Fertilizer Company it didn't invest heavily in the industry until recently. Grace Chemical Company was formed in 1952. In 1954 Grace acquired Davison Chemical Company, of Baltimore, a leading producer of catalysts, silica gels, sulphuric acid, phosphates and mixed fertilizers. Later in the same year Dewey and Almy Chemical Company, of Cambridge, Mass., was merged into the Grace organization. It makes chemical specialties, including plastic bags for packaging refrigerated and frozen foodstuffs, sealing compounds, organic chemicals, and battery separators.

Grace Chemical Company is headed by experienced industrialists. Charles E. Wilson is chairman of the board of both W. R. Grace & Co. and the chemical company. William J. Haude, formerly president of the Pittsburgh Agricultural Chemical Company, is vice-president and general manager. John G. Carriere, previously manager of the Hanford (Washington) Works of the Atomic Energy Commission, is vice-president and plant manager.

From South America to Memphis, then, the Grace Company has come full circle in its 101 years of existence. It was founded on the nitrate trade of the past century and is now venturing further in that field through the fascinating technology of today's high-pressure synthetic chemistry.



CARBON-DIOXIDE COMPRESSOR

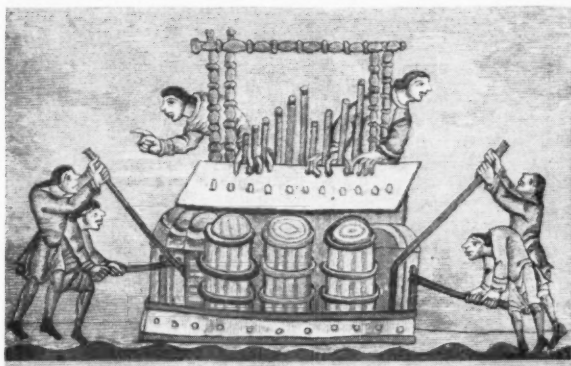
When oxygen obtained by distilling liquid air is made to react with natural gas, the products are hydrogen and carbon monoxide. The latter is then caused to react with steam to form carbon dioxide and more hydrogen. Some of the carbon dioxide is compressed in the unit illustrated to around 3215 psi pressure so that it will

combine with ammonia to form urea. The remainder, which is surplus, is piped to a nearby plant of the Cardox Corporation, where it is used in making dry ice. The compressor, which is similar in design to the larger machines in the plant, has four stages and is driven by a 900-hp motor.

THE PIPE ORGAN

This Air-operated
Instrument Dating from the
Pipes of Pan Has Been Highly Developed

JANE S. MULLER



BETTMANN ARCHIVE PRINT

MORE WORK THAN PLEASURE

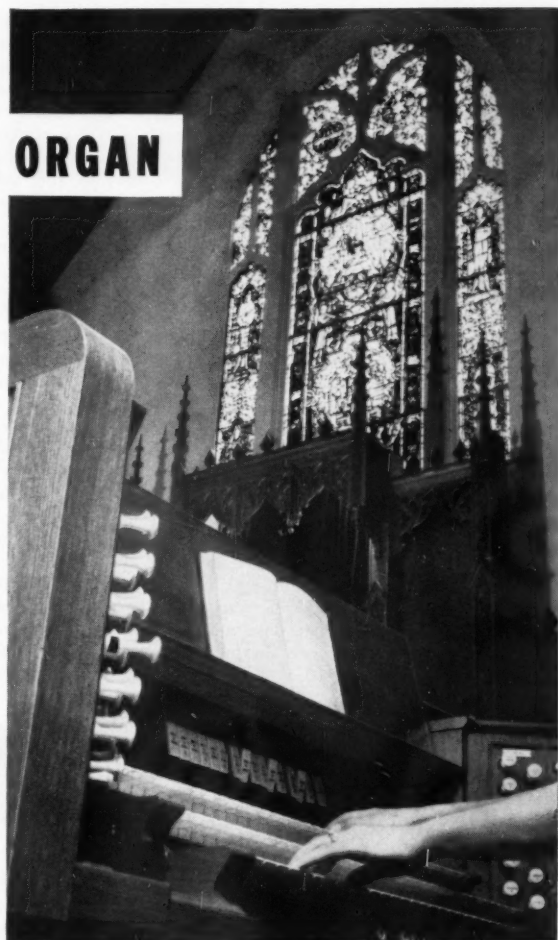
Back in the twelfth century, manpower was essential in playing the pipe organ and one wonders if the quality of the music resulting from the concerted efforts of half a dozen men would have pleased modern listeners. Real physical strength was required of the organists and those who worked the bellows.

THE pipe organ is the largest, most powerful, most versatile and one of the most ancient of all musical instruments. Its origin dates back more than 5000 years supposedly to the syrinx—the Pipes of Pan known to the Greeks, Chinese and Hebrews—and it is said to have provided music at the lavish entertainments in the days of the Roman Empire. In the seventh century a rough approximation of the modern organ began to appear in churches, although the Talmud tells us that an instrument of ten pipes played by a keyboard was in existence in the second century.

There was a time in the Middle Ages when the use of the organ in houses of worship was abandoned, for some priests actually considered its function at divine service "scandalous and profane." Much later, in Scotland, a preacher referred to the instrument derisively as a "Kist (box) o' whistles." But today no church, except a Quaker meeting house, would be complete without an organ. The next two decades, according to the *Wall Street Journal*, will see the construction in the

United States of an estimated 105,000 new houses of worship and the modernization of possibly 285,000 existing ones. The former certainly will require new instruments, while those installed in the latter will probably need overhauling if not replacement.

It is this building program which, the *Journal* tells us, accounts for the tremendous resurgence of business—the second great wave of prosperity—in the pipe-organ industry. The first took place more than a quarter of a century ago when there was a rush of orders for instruments from new motion-picture theaters and private homes. The present backlog should keep employees of the larger manufacturers on the job well beyond the normal 40-hour work week through 1956 and possibly into 1957. It is interesting to observe that there is no enforced retirement age in the business, for several companies have nonagenarians at work. This may be due in part to the difficulty of finding men skilled in the trade. Some firms are solving this problem by importing trained organ builders from abroad.



PHOTO, M.P. MOLLER COMPANY, INC.

A GRACIOUS HERITAGE

Down through the centuries the beautiful surroundings in which pipe organs have for the most part been placed have contributed to the continuance of the gracious and reverent atmosphere engendered by their music. The spiritual environment of a church combined with the playing of an accomplished organist will thrill and move a listener whether or not he be musically inclined.

The history of the pipe organ is a story of man's efforts to place many instruments at the command of one performer. Its cornerstone is the beak flute, so named because of its beak-like mouthpiece through which the player channels his breath to produce music. The ancients discovered that a number of these flutes, each of different pitch, could be sounded simultaneously by one person.

Then someone worked out an arrangement whereby as many as a dozen of the instruments could be placed end up on a wind box supplied with air by bellows. As the number of flutes or pipes increased, more bellows were required to furnish the air and more manpower

was needed to operate them. An early book of Saxon origin shows a picture of one instrument which called for the efforts of four men at the bellows and two organists. It did not take long to learn that it was easier to force air from the bellows into the pipes by body weight than by arm muscles, and "bellows-treaders" could be seen hopping from one to another of a series of feeders. But many hundreds of years were to elapse before bellows were abandoned for rotary blowers driven by electric motors.

Until the beginning of the nineteenth century, when the organ reached the form it was to maintain until the development of electric blowing equipment and electropneumatic action, air under pressure was supplied by bellows to wind-chests and was admitted to the pipes by mechanical means. Known as the tracker-action organ, it had a pallet and slider windchest—an oblong box containing valves or pallets held by springs against vertical channels extending to the pipes resting on the chest. Each pallet released air into a single pipe and was opened and closed through the medium of a thin strip of wood or tracker

connected to a pull-down wire at one end and a key at the other, each key having a corresponding pallet in the windchest. Between the pallets and pipes were other valves—the sliders—each of which controlled the flow of air to a row of pipes known as stops or registers in the industry. Hence, to produce a sound, the player had to pull out a stop knob on the console to operate a slider and to depress a key to operate a pallet.

The average church organ of that period had three or four windchests each with its own group of pipes, namely: the great or loud-speaking organ; the swell organ with Venetian shutters which opened and closed to modify the tone; the soft-voiced choir organ; and the large deep-pitch pipes played by the pedal keyboard. It took a lot of physical effort to bring out the full power of one of those instruments, and sometimes the organist had to stand on the pedals and put all his weight on the keys to get the big chord he desired.

The windchest was never equal to the task of supplying air at constant pressure to all its rows of pipes. While enough wind might be admitted through

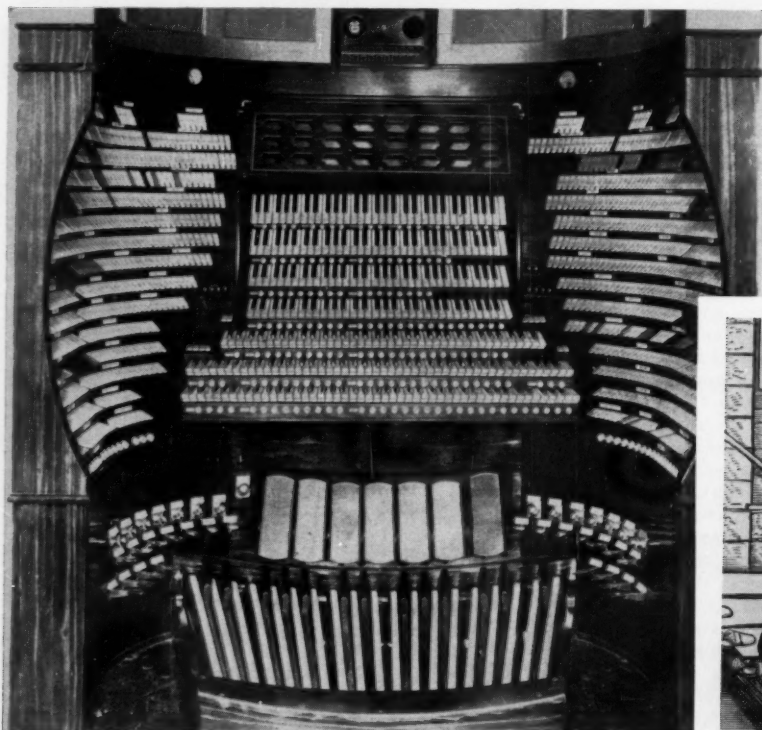
the channels when two or three stop knobs were drawn, there was a loss in pressure when all were pulled out, with the result that the pipes were more or less flat in pitch. In addition, when one pipe was meant to speak, air leakage was apt to cause adjacent pipes to sound. In dry weather, when wooden parts would shrink, leakage was aggravated; on damp days the sliders would swell. But "with all its difficulties," to quote William H. Barnes in *The Contemporary American Organ*, "the tracker-action organ was a miracle of mechanical skill for its time."

Improvements through the years have turned the organ into an instrument that can be played with comparative ease, and no longer is the performer called an organ-beater as in the early days when a heavy blow of the fist was sometimes required to produce a single note. In 1832, Charles S. Barker, a chemist's assistant of Bath, England, invented what was known as the pneumatic lever, a small bellows that relieved the organist of the physical effort of pulling down the heavy pallets. His device was nothing more than a primitive form of the pneumatic control circuit now widely used in industry. Slight pressure by the player on a key actuated a small valve and admitted compressed air to the bellows, causing it to expand, to open the associate pallet in the windchest and thus introduce air into the pipe. An added advantage of this sys-

PUMPING WITH BOTH FEET

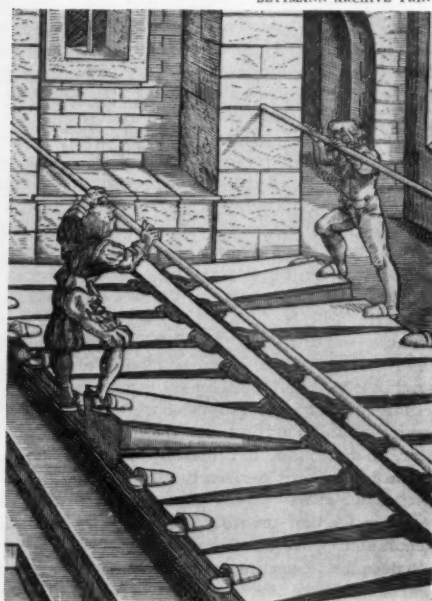
Bellows-treaders, who hopped from one to another of a series of feeders, replaced men with muscular arms when it was discovered that more air could be forced into the pipes of a large organ by body weight.

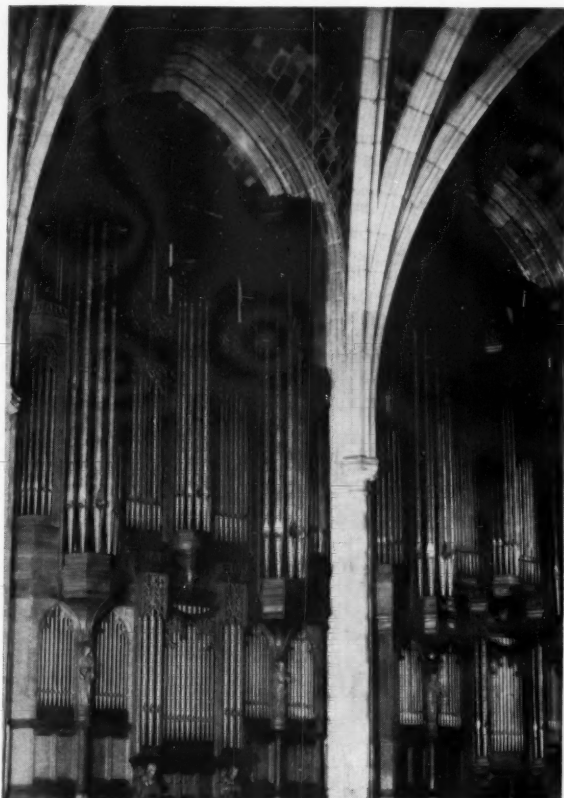
BETTMANN ARCHIVE PRINT



CONSOLE OF WORLD'S LARGEST ORGAN

The only instrument to possess seven manual keyboards, this console of the organ in the Atlantic City (N. J.) Auditorium is also unique in that it has six octaves in the swell manual and seven in the great and grand choir, the normal number being five. Still another feature is the largest known single "speaking" pipe. It is 64 feet 9 inches long and increases gradually from 10 inches square at the bottom to 36 inches at the top. Of Oregon fir and 3 inches thick, the tree from which it came is said to have been about 785 years old.





IN CADETS' CHAPEL

The chapel of the U.S. Military Academy at West Point, N.Y., is reputed to have the largest church organ in the western hemisphere. Our picture shows the beautiful arrangement of pipes of the Moller built instrument.

tem was that there was less chance of ciphering—sounding a pipe without pressure on its key.

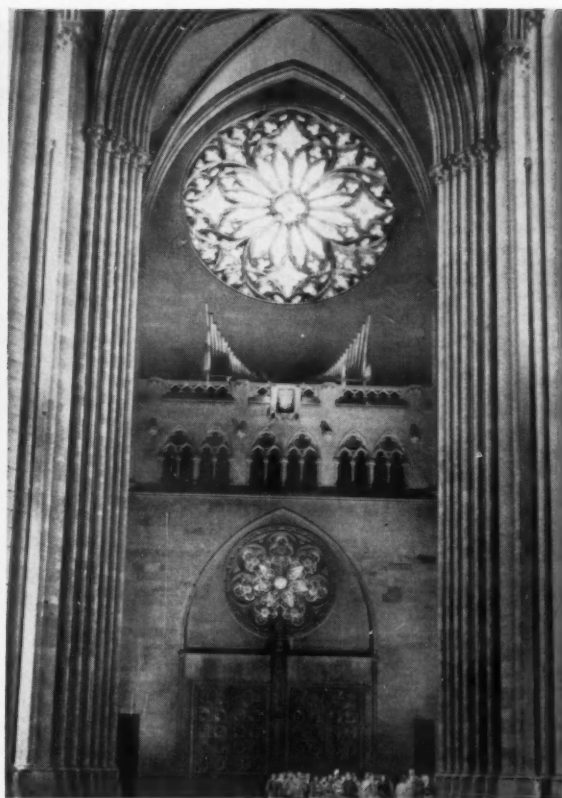
As Barker's pneumatic lever did not receive immediate recognition in England, the inventor studied organ building for several years. In 1837 he went to France, and two years later patented his brainchild. Subsequently he became a voicer (a specialist who tunes organs by giving pipes their final shape after installation) for the firm of Dicroquet, later Merklin, and then a partner of Verschneider.

But with Barker's contrivance difficulty was experienced with the trackers, especially when they had to be run down underneath the church floor and then up again as in the case of a large divided organ. An effort was made to remedy this by means of the so-called tubular pneumatic action whereby air impulses were conveyed through a series of small-diameter lead tubes placed between the end of a key and Barker's pneumatic lever. It was incorporated in an instrument built for St. Paul's Cathedral (London) in 1872 and Sir John Stainer, or-

ganist at the time, described it as a "triumph of mechanical skill," whereas the eminent English organist W. T. Best considered it "the most damnable invention ever placed inside an (concert) organ." In this country, some manufacturers went straight from Barker's device to electropneumatic action, and today only very small organs are occasionally provided with the tubular pneumatic system to save the expense of a generator and magnets.

The first practical application of electricity in this field was made by Dr. Albert Peschard, a Parisian, who developed a system of electropneumatic control in 1861 and patented it in 1864. Associated with the Barker pneumatic action, it was installed in an organ at Salon, France, in 1866. While others such as Du Moncel and Froment and Doctor Gauntlett had preceded Peschard, none of their efforts had borne fruit.

The early instruments of this type were none too responsive and reliable largely because it was not possible to obtain good electrical contact, and even as late as 1890 Henry Willis & Sons (England) refused to produce electric-action organs for fear the firm would lose its fine reputation. What was probably the first electric-action organ in the United States was built by Hilborne L. Roosevelt in 1876 for a private home.



THE STATE TRUMPET

Located beneath the great rose window and above the main entrance to the Cathedral of St. John the Divine in New York City is the State Trumpet, a 61-pipe stop and an achievement of Aeolian-Skinner Organ Company which recently reconstructed the church's 4-manual instrument. High air pressure is required to produce the almost percussive articulation and fiery tone characteristic of the valveless trumpet, which projects straight out from the wall.

An instrument of one manual with nine speaking stops, it was subsequently dismantled. Roosevelt unquestionably was a pioneer in this country in organs of this type.

But it is to Robert Hope-Jones, the famous English organist-electrician, to whom we are mostly indebted for electropneumatic action as we know it today. His principal contribution to the system was a tiny horseshoe-shaped electromagnet which moved a small iron disk (the armature) for a distance of about 1/100 inch. The disk served as a 2-way valve that operated the pipe valves through pneumatic impulses. Included among the many other Hope-Jones improvements now in general use are electric couplers, silver electric contact members and multiple key contacts, inclined keyboards, movable consoles, bellows springs and stop keys.

The large pipe organ with its pedal

keyboard, manuals, stop knobs, tilting tablets and thousands of feet of wire in the electric circuits between the console and the pipes is a complex instrument. (Tilting tablets may be used to select stops or to connect two or more of the manuals, or a manual and pedal keyboard, or keys on the same keyboard an octave apart so they will act in unison when one is played.) It is operated by direct current at 8 to 15 volts supplied by a generator usually mounted on the same shaft as the motor that turns the blower fans.

The pipes are of four basic types: flutes, reeds, diapasons and strings. The flutes or flue pipes are akin in appearance and behavior to the penny whistle or beak flute. In reed pipes the wind vibrates a curved metal tongue over the opening, thus causing them to speak, the length of the tongue controlling the pitch. The diapasons are responsible for the foundation tones or bass of the organ, which cannot be reproduced by other instruments, and the sounds of the

strings are comparable to those made by violins and other orchestral strings. No two pipes in an instrument are identical. Made of wood or metal, or both, their diameters vary as well as their length.

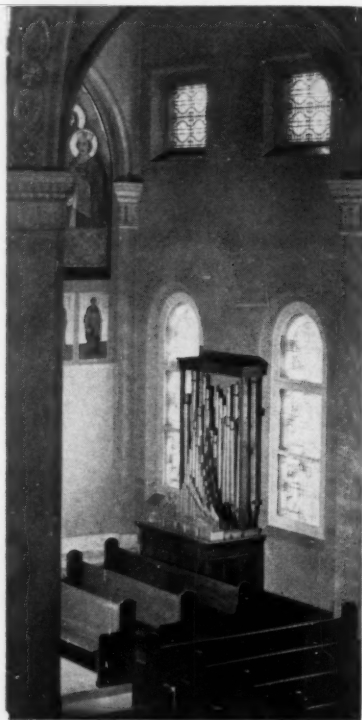
The instrument is brought into action by the flick of a starter switch on the console. This actuates the electric blower which sends air into reservoirs and through large ducts into the wooden windchests on which, as has already been said, the pipes rest. The organist then proceeds to pull out stop knobs, move tilting tablets and depress keys and pedals in accordance with the music in front of him, thus making instantaneous and continuous contacts through electromagnets with the valves that allow the air to flow into the chosen pipes. The blower is controlled to supply air at constant pressure, and a mechanical device interposed in the air line enables the player to give tremolos to any tones.

Organs built in the 1920's for private homes ranged in cost from \$5000 to \$30,000, while those installed in churches and public places involved outlays of as much as \$200,000—the sum reportedly spent on the instrument placed in John Wanamaker's department store in New York City in 1921. When that establishment went out of business last year the organ was sold at auction for \$1200. Though an opening bid of \$10,000 was asked by the auctioneer, the first

offer was only \$1000. It was purchased by the American Institute of Organ Builders mainly for the pipes, some of tin and lead, which are said to have a value of about \$70,000. They vary in size from that of a pencil to units around 18 inches in diameter and 32 feet long. Approximately 90 percent of them are salvageable.

One of the most interesting pipe organs in America from the historic point of view is that in the Tabernacle of the Latter Day Saints of Jesus Christ in Salt Lake City, Utah. Reaching the site of the settlement late in July 1847 after a long overland trek, the Mormons naturally were concerned with such elemental problems as securing food and housing, but even so, within less than a week, they had chosen a site for their temple.

Twenty years later an organ with 8000 pipes was dedicated in the Tabernacle. During those two decades Joseph Ridges, an organ builder who had come to the United States from England by way of Australia, had led members of the church in gathering materials and constructing the instrument. Suitable timber for the large pipes was hauled 300 miles from the Hills of Parowan, and sometimes as many as 60 yokes of oxen were needed for the work. Originally air was fed into the windchests by bellows operated by six men. They were replaced first by a water motor and later by an electric



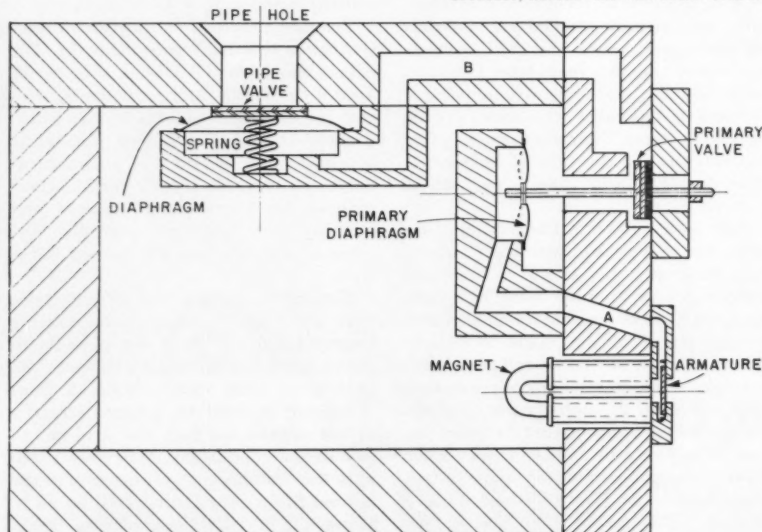
PIPES OF TINY ORGAN

The pipes shown here belong to what is probably one of the smallest modern church organs. No larger than a spinet piano, it is of recent construction and was designed and built by Aeolian-Skinner Organ Company for the Greek Orthodox Cathedral in Boston. A one-manual instrument with three stops and no pedal keyboard, it fully meets all the demands made upon it by the musical requirements of the congregation and the acoustical characteristics of the building. The console is separate.

CROSS SECTION OF A BASS CHEST

The chest is filled with air at whatever pressure the particular organ requires. This wind forces the armature of the electromagnet (a small circular soft-iron disk) against its outlet port so that it flows between the legs of the magnet. When the latter is energized, the armature is pulled up against the inner port, simultaneously sealing it and exhausting channel "A." This causes the primary diaphragm to collapse and to move the primary valve which, in turn, exhausts channel "B" and causes the pipe-valve diaphragm to collapse. In this way the pipe valve is drawn down, allowing pressurized air to enter the organ pipe, which then "speaks." A small amount of electric current—1/10 of one ampere at 10 volts—controls a large volume of air, thus not only permitting the cycle to take place within seconds but also rapid repetition.

COURTESY, AEOLIAN-SKINNER ORGAN COMPANY



CRAFTSMANSHIP IMPORTANT ELEMENT

The construction of a pipe organ calls for much handwork, as these pictures of skilled artisans in the Moller factory at Hagerstown, Md., indicate. The man shown below is putting finishing touches on a rank of flue pipes. The "voicer" at the right must possess an acute sense of hearing as well as touch to detect the slightest differences in tonal quality and to make the delicate adjustments needed to bring each pipe to the correct pitch, color, transparency and timbre.



motor. The 5-manual instrument was recently renovated by Aeolian-Skinner Organ Company.

Students at Iowa State College in Ames, Iowa, enjoy music played on a 20,000-pipe instrument in the Memorial Union Building. Because of the advent of sound movies, an organ in a Madison, Wis., theater had lost its usefulness and two Iowa State alumni bought it for the college in 1936. Dismantled, it was trucked to the school where chambers to house the pipes were built on each side of the auditorium stage. Fortunately, the architect who designed the structure had foreseen the possibility of such an installation and made provision for it.

The reconstructed 4-manual organ of the Cathedral of St. John the Divine

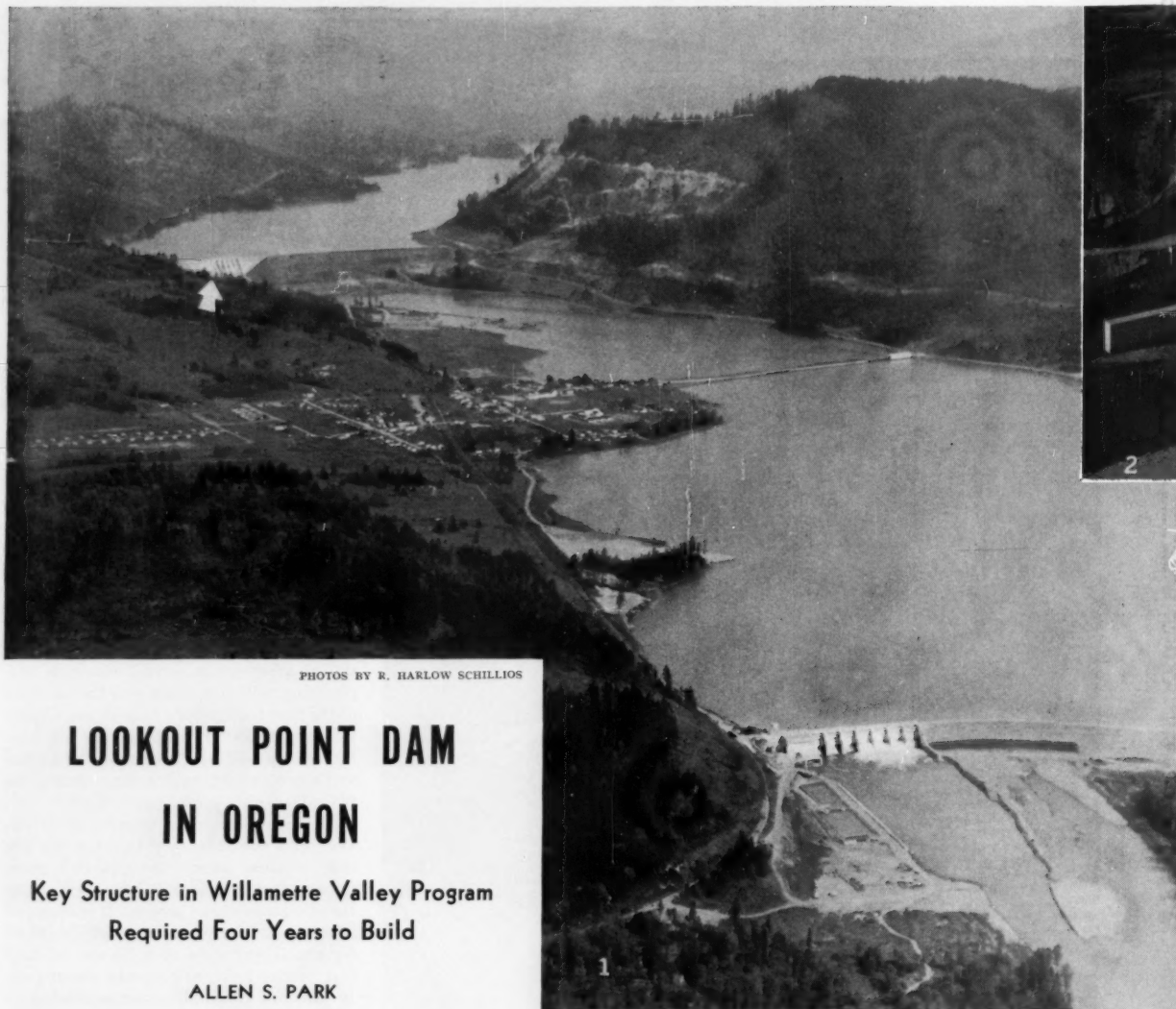
on Morningside Heights, New York City, is a masterpiece of its kind and ranks among the great organs in the United States. Originally built in 1910 under the direction of Ernest M. Skinner, its renovation was begun in 1953 under the supervision of G. Donald Harrison, president of Aeolian-Skinner, and took fourteen months to complete. Together with his staff he spent weeks in studying the equipment, acoustics of the edifice and the musical traditions of the church before the work of reconstruction was taken in hand.

From a 5650-pipe instrument it has been converted into an 8035-pipe organ of much improved tonal quality. One of the new features is a brilliant reed stop named The State Trumpet which was inspired by the trumpeters who play

in London's Westminster Cathedral on occasions of high festivals. It was designed after much careful research and planning, which necessitated the services of the first trumpeter of the Boston Symphony Orchestra who played for Mr. Harrison at different points in the edifice to determine where the stop should be placed to obtain the best effect.

The State Trumpet consists of 61 silver pipes and is located beneath the big rose window above the church's main entrance, which is 500 feet away from the choir and organ proper. It is sounded with air at 50 psi pressure, which called for the installation of a blower at that end of the nave and special mounting. Because of the high pressure needed to "achieve the almost percussive articulation and fiery tone characteristic of the valveless trumpet," the pipes, which project straight out from the wall, are shackled to steel guy wires bolted to a metal plate set in the masonry so that they would not be blown loose from the windchest and go sailing out over the heads of the congregation like so many projectiles.

Two decades ago the electronic organ made its appearance and has found a wide field of application. This instrument requires neither an air system nor pipes and therefore has the advantage of reduced bulk and mobility. However, old-line manufacturers of big organs, especially for churches and large public buildings, do not consider this comparative newcomer a threat to their business because it does not approach the pipe organ in richness of tone and orchestral effect. As E. Power Biggs, one of America's foremost concert organists has put it: "If the instrument doesn't have pipes it isn't an organ at all."



PHOTOS BY R. HARLOW SCHILLIOS

LOOKOUT POINT DAM IN OREGON

Key Structure in Willamette Valley Program
Required Four Years to Build

ALLEN S. PARK

ABOUT twenty years ago, an Oregon governor appointed a committee of Willamette Valley citizens to draw up a long-range plan for developing the valley's water resources. On June 25 of this year, Lookout Point Dam, a key structure in the program, was dedicated, along with Dexter Dam, a lesser auxiliary structure just downstream. Lookout Point Dam is the first of four barriers planned on the Willamette by the U.S. Army Corps of Engineers and joins five smaller dams built on tributaries of the stream in 1942 and 1953. Together with its powerhouse, it represents an expenditure of \$23,000,000 and four years of construction work, with up to 850 men employed.

The Willamette flows northward roughly parallel with the coast line and joins the Columbia at Portland. It is a temperamental stream that has often become unruly and wrought havoc, especially at Portland. The series of dams

existing or projected will bring it under control and also contribute sizable blocks of electric power that will be welcomed in the fast-growing Northwest.

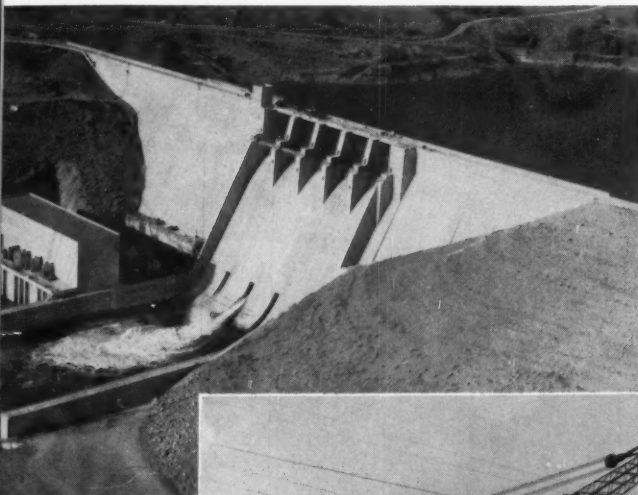
Lookout Point Dam, an earth-fill structure with a large concrete spillway section, is located on the Middle Fork of the Willamette about 23 miles southeast of Eugene, Ore. The over-all length is 3380 feet and the maximum height 280 feet. The embankment contains 7,489,000 cubic yards of material and has a maximum thickness of 1235 feet at the base, tapering to 24 feet at the crest. The spillway, which is as large as many good-sized dams, called for the use of 838,000 cubic yards of concrete.

The dam will back up the water 14.2 miles and create a pool having a surface area of 4360 acres. Storage capacity will be 456,000 acre-feet, of which 340,000 acre-feet is being allocated for flood control and the remainder for power generation. The powerhouse is located

at the base of the spillway section and contains three generators having a combined capacity of 115,000 kilowatts. The water is fed to them through 18-foot-diameter, 140-foot-long steel penstocks extending through the dam.

Construction at Lookout Point was handled by a firm known as M-K-M (Morrison-Kiewit-Macco), a joint venture of Morrison-Knudsen Company, Inc.; Peter Kiewit Sons' Company and Macco Corporation, with Morrison-Knudsen acting as sponsor. The dam cost approximately \$20 million and the powerhouse—built under a separate later contract—about \$3 million. Work on the dam began in May 1950, and was completed in March 1954, with construction and outfitting of the power plant continuing until last spring.

Excavation at the abutments and along the axis of the dam involved the removal of approximately 700,000 cubic yards of earth and 61,000 cubic yards of

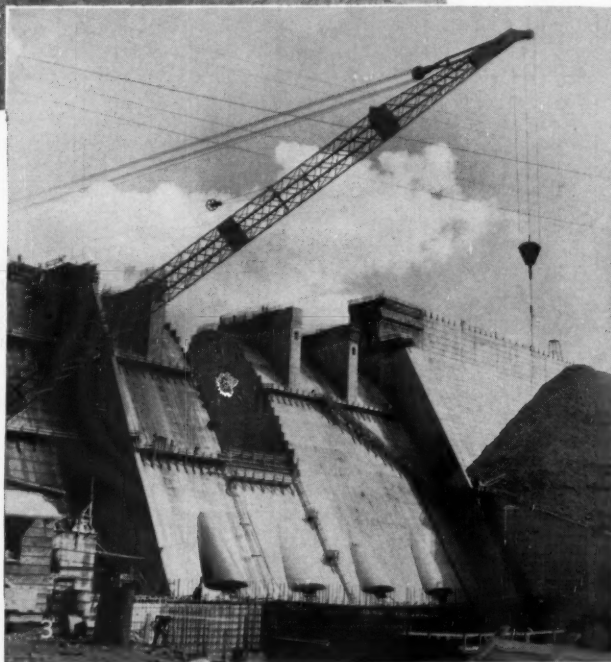


1 Lookout Point Dam is at the upper left (white arrow). From the scarred height rising above its right end was quarried rock for concrete aggregate. The town in the left-center is Lowell. Dexter Dam, a small reregulating structure, is at the bottom.

2 Close-up of the 278-foot-high concrete spillway section of Lookout Point Dam and the powerhouse at its base.

3 Spillway section under construction in 1954. The boom is that of a Manitowoc crane, one of two that delivered 4-cubic-yard buckets of concrete to the forms. An overhead cableway handled 8-cubic-yard buckets.

4 A piece of drill steel being put in an Ingersoll-Rand wagon drill as quarrying of rock for concrete aggregate was started atop Eagle Rock 1250 feet above the dam site



rock. Gravel, which makes up the bulk of the fill material, was obtained a short distance upstream and was hauled to the dam site by 25 Euclid trucks of 15 to 30 yards capacity. Clay for the core of the earth-fill structure was similarly brought in from a deposit 1½ miles upstream. Because of an overabundance of rain, these activities were limited to an average of four months a year.

Aggregate for the concrete was quarried from the top and one side of Eagle Rock, a promontory that rises 1250 feet above the stream at one end of the dam. Most of the material shattered by blasts hurtled down the mountainside and was trucked from there to a nearby crushing and screening plant with a capacity of 400 tons an hour. On one occasion 12½ tons of dynamite in 1000 blastholes was detonated and brought down some 20,000 cubic yards of broken rock.

From a mixing plant, located near the aggregate plant, concrete was hauled to

the spillway area by railroad and thence delivered to pouring locations in 4- and 8-yard buckets either by two Manitowoc cranes or an aerial cableway. The latter had a stationary head tower of structural steel that rose 428 feet in the air from its 20-foot-square base. At the other end of its 2600-foot span was a 170-foot-high tail tower that moved through an arc on a railway 950 feet long. This cableway was reputed to be the largest ever built for handling 8-cubic-yard buckets.

With the two cranes and the cableway all in action, up to 15,000 cubic yards of concrete was placed weekly, and during the peak of operations as much as 2800 cubic yards was handled daily. During the winter of 1952 the fog was so bad that flares were placed on the buckets of concrete so that the men at the forms could see them coming and all trucks ran with their lights on.

The powerhouse, which is 230 feet

long, 132 feet wide and 130 feet high, and windowless, required 35,000 cubic yards of concrete, which was all placed with the aid of a stiff-leg derrick that was first used at Hoover Dam and afterwards at Norfolk Dam in Arkansas, Kortes Dam in Wyoming and Cabinet Gorge Dam in Idaho.

Construction involved the clearing of 2500 acres of heavily timbered land and the relocation of tracks of the Southern Pacific Railroad and a highway. All these operations were carried out under separate contracts.

Approximately a dozen more dams are projected to complete the Willamette Valley improvement program, which may ultimately cost close to half a billion dollars.



READY TO GO

Five of 53 identical Mack tractor-trailers bought in 1953 are shown below and, at the left, another one is pictured on the road. The tractors of these and 40 newer models are all equipped with air starters. The latter turn over the 170-hp diesel engines at higher rpm than electric starting mechanisms and therefore produce faster, surer starts, especially in freezing weather.



Cheaper and Surer

AIR STARTING PROFITS TRUCKING FIRM

**Large southern highway
carrier reduces annual maintenance
cost \$34,000 by changing to new system**



BY SELECTING compressed-air starters for the 170-hp diesel engines that power 93 of its highway tractors, Carolina Freight Carriers Corporation, of Cherryville, N.C., is profiting to the extent of many thousands of dollars a year. Savings on equipment maintenance alone total \$34,581.12 annually. In addition, other sizable but variable sums are received from shippers by reason of the fact that articulated vehicles provided with air-starter systems have greater trailer carrying capacity than those with conventional electrical systems.

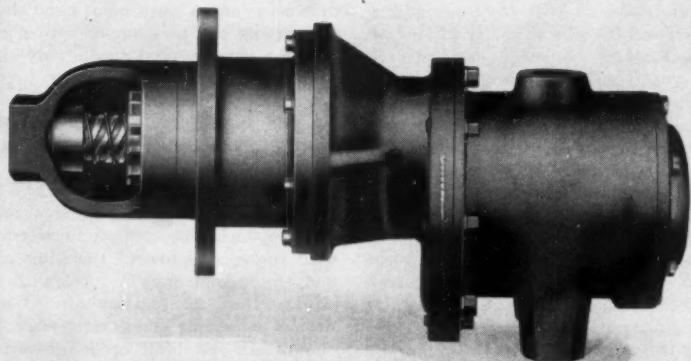
These statements are based on the company's experience with 93 new Mack tractors, each with an Ingersoll-Rand size 9BM air-starting motor. In Novem-

ber 1954 it acquired 40 more vehicles of that type. Previously the concern had 200 other tractors and 50 trucks in service, all with electric starters. Because starting with air was a new experience, comparative operating records were carefully kept.

Electric starting is done with a 24-volt system. Each tractor using that system is equipped with four 153-ampere-hour 6-volt batteries, in series, to supply current for cranking, lighting and other purposes. An average of three batteries has to be renewed each year at an expenditure of \$70.80. Current breakers on the series-parallel switch, a starting solenoid switch and the starting armature all have to be replaced on

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AIR-STARTING MOTOR

A mechanic (below) points to the Ingersoll-Rand 9BM starting motor in one of the tractors. Slightly smaller than a conventional electric starting armature, it is bracketed to the flywheel housing on the left side of the engine. A complete, bare motor is shown at the left. It develops approximately 12 horsepower when supplied with air at 120 psi.



HEADQUARTERS

Carolina Freight Carriers Corporation maintains executive offices, a home terminal and maintenance shop at Cherryville, N.C. It is one of the largest highway common carriers in the South.

an average twice every twelve months, and their respective annual costs are \$57.39, \$31.28 and \$78.67. The most vulnerable element, however, is the generator, which normally is renewed four times a year at an outlay of \$218. These items, which include labor charges, add up to \$456.14 per tractor.

In contrast, replacements in the case of a new air-started tractor come to only \$84.30, including labor—a reduction of \$371.84, or 81 percent. This saving is

made possible because the electrical system, when relieved of the starting load, can be made smaller and simpler. Two instead of the former four 6-volt batteries provide ample current for lighting and other services. Also eliminated are the armature, series-parallel and solenoid switches and 20 feet of battery cable.

Furthermore, according to Earle Harmon, the line's assistant superintendent of maintenance, the decrease in electrical load has increased the service life of the two remaining batteries and doubled that of the generator. He states that many of the batteries that were in the Macks when they were purchased in 1953 are still there. Based on this experience their life expectancy has been set at two years, and this seems conservative.

New equipment required for the air-starting system on each tractor includes the starting motor itself, a 56x13-inch aluminum air-storage tank, the necessary control valves and a short length of 5/8-inch copper tubing. There is no need for additional compressor capacity because the 12-cfm unit installed for braking service has a sufficient reserve supply to meet the requirements of the starter.

The trucking concern does not expect to replace the Ingersoll-Rand starting motors during the service life of the tractors. It is so sure of their durability that it keeps just two spare units in stock to relieve the 93 in use. Maintenance of the air systems has so far called for little more than cleaning the valves occasionally and the starting motor once a year. With 53 of the units in their third year of service, the only outlay for upkeep has been \$8 for parts and \$3.50 for labor, a total of \$11.50. This freedom from major attention and expense is not unusual for pneumatic equipment. Nothing in the starting motor will burn out, and it has so few working parts that it is virtually fool-proof in operation.

In computing the comparative annual electrical repair cost for each of the 93 new tractors, Mr. Harmon figured a life expectancy of two years for each of the 6-volt batteries, or an annual replacement expenditure of \$24.30 for each tractor. To replace or rebuild one generator a year costs \$54.50 per tractor. These figures include labor. The total outlay for maintenance of the air-starting and electrical systems is \$84.30 per annum for each tractor, representing a per unit

saving of \$371.84 as compared with electric-starting tractors of comparable size, or \$34,581.12 a year for the full complement of 93 air-starting tractors.

Even this figure does not represent the full measure of savings on electrical upkeep. Mr. Harmon reports that fewer roadside repairs are necessary with air starters. For example, if an electric-starter tractor has generator trouble, day or night, the driver must stop for a time-consuming and possibly expensive repair job. If an air-starter outfit has generator trouble in daylight hours the driver keeps it rolling. If the trouble develops at night, or with night approaching, the most that is needed is a quick charge for the batteries to provide current for lights, and he can then continue on his way. Another maintenance cost that is eliminated by air starting is trouble shooting when something goes wrong with the relatively complex 24-volt series-parallel battery system.

Supplementing this saving is the additional earning capacity of air-started tractor-trailers. Weight restrictions apply to the unit as a whole, and if the tractor is lightened, the pay load of the trailer can be increased that much. In this case the figure is 98 pounds. The

value of this additional weight on every trip varies widely with the commodities hauled and the practicability of loading to the limit. Each trucker can translate this weight advantage into such added revenue as his situation permits. At Carolina Freight, the 98 pounds are used frequently when carrying frozen foods, but only occasionally when the cargo is bulky textile of low specific gravity. A long analysis of loads would be necessary to determine the number of dollars gained, but it is safe to say that the light weight of air-starting equipment has been responsible for increasing revenue by many thousands.

Improvement in cold-weather starting has been mentioned as one of the advantages of an air system. Tests by Carolina Freight's maintenance crew indicate that a single starting-air tank has sufficient capacity, even in cold weather, to crank each diesel about four times. In practice, of course, a diesel has to be "kicked" over only a couple of times to start it. The compressor keeps the system at or near full charge all the while the tractor is in operation. In emergencies, however, the tank can be recharged in a matter of minutes either at the maintenance shop, at any service

station or by a passing tractor. On such occasions, a convenient hand shaker coupling can be snapped into place, or else a conventional needle valve can be used.

On each of the 93 Macks the starting and braking air systems are tied together. The compressor, on the right side of the engine, is connected by 3/4-inch copper tubing to one of two air storage tanks for the braking system. Short 5/8-inch lines connect this receiver with the second one of the same size, and the second one, in turn, with the storage tank for starting air. Under normal operating conditions, when the compressor has built up a pressure of 100 psi in the two braking-system receivers, an air-gun valve opens and permits air to flow into the starting-system tank. When the pressure reaches 120 psi in all three receivers, all valves close and the compressor stops running. Each system is designed to function independently, and the control valves are arranged so that no air can be bled from one tank to another.

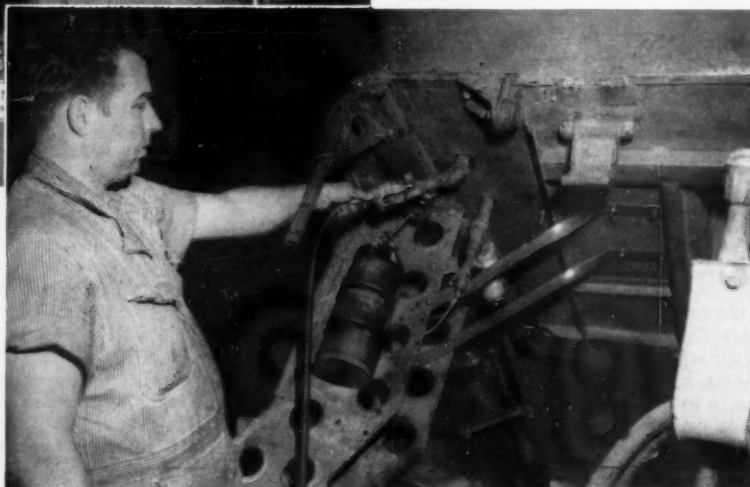
The 9BM motor is of the Multi-vane type and starts the engine through a Bendix drive that matches the motor's characteristics. Because of its simple construction, the motor can be serviced by the average engine mechanic.

Carolina Freight Carriers Corporation is one of the South's foremost highway common carriers and maintains 37 agencies, call stations and terminals in principal cities along the eastern seaboard. It was started in 1931 with three trucks. C. G. Beam is president and D. F. Beam is secretary-treasurer. It now has 293 tractors, 50 trucks and more than 350 semitrailers. Its operating territory extends from Key West, Fla., northward to Boston, Mass., and westward as far as Atlanta, Ga. It is the only trucking common carrier with authority to handle direct shipments of general commodities from Florida to New England.



STARTING-AIR TANK

Earle Harmon, assistant superintendent of maintenance for Carolina Freight Carriers points (above) to the 56x13-inch aluminum starting-air receiver installed in a tractor cab housing. The tank holds enough air at 120 psi pressure to start an engine four times and is normally kept fully charged by the compressor that supplies air for the vehicle's brakes. In an emergency it can be recharged quickly at a service station, by a passing tractor, or by means of a hand-shaker coupling, as shown at the right.



Denver Claims Record Excavation

AN EXCAVATION that is now nearing completion in Denver, Colo., is claimed to be the biggest one ever made for a single building project. It involves digging to a maximum depth of 55 feet throughout most of a ground area of 200,000 square feet, or roughly $4\frac{1}{2}$ acres. One entire block, from which Denver's old courthouse was razed a few years ago, plus a considerable section of an adjoining block and the street that separates the two constitute the working site.

The development, or complex as it is termed, is a joint undertaking by Webb & Knapp, Inc., New York realty firm, and Daniels & Fisher, Denver's oldest department store. The principal structure in the group will be a 20-story hotel, the largest to be erected in the Rocky Mountain region in the past 25 years and the first one in Denver to include modern and complete convention facilities.

The store, which will rise five stories and have a floor area of 400,000 square feet, is to be the biggest one built west of Chicago during the postwar period. It will face Sixteenth Street but will be set back 135 feet. The intervening space, a full block long, will be made into a plaza. At one end will be a sunken garden with an ice-skating rink similar to but larger than the one in Rockefeller Center in New York City. The rink will be flanked by dining facilities for winter use and the entire space will serve that purpose in summer.

The hotel, across the street from the store, will be a block-long narrow structure with more than 700 rooms and will be air conditioned throughout. A 2-story extension at the rear will house retail shops, and back of them will be a wing connecting with the second floor of the hotel. It will contain three ballrooms (one with a seating capacity for 2500) and an auditorium suitable for holding conventions. The roof of the merchandising section will be used in favorable weather for outdoor dining and special displays and fashion shows put on by Daniels & Fisher. The hotel and department store will be linked by a bridge across the street at second-floor level.

One of the outstanding features of the development and the reason for the huge excavation is that there are to be four



DENVER DIGGINGS

The Courthouse Square plot during the first stages of excavating to a maximum depth of 55 feet. A department store will be erected on the site, with a hotel across the street to the left. Under both, as well as the intervening street, will be four basement levels, three of which will be used for parking automobiles.

subsurface levels of which three are intended for parking automobiles. The lowest basement will house boilers, air-conditioning machinery, a laundry and other essential service equipment. The entire working site is being gouged out and a new street will be built after the underground facilities are installed. With accommodations for 2500 cars, the parking place will be the largest privately owned one in any urban area of the country. The floors will be connected by ramps. Parking by hotel patrons is expected to be heaviest at night, making much of that space available during the day for public parking at competitive rates. Underneath the department store will be an automobile showroom and an accessories store, as well as a complete auto-servicing shop.

According to Webb & Knapp Construction Corporation, which is in charge of the project, more than 500,000 cubic yards of earth, weighing in excess of 600,000 tons, will be removed from the huge hole in the ground. About 70 percent of it is gravel, deposited there in bygone ages by Cherry Creek, which now flows a short distance away. Cherry Creek was one of the streams panned for gold by the pioneers of 1859, and there is some reason to believe that the material being dug out is rich enough to warrant processing.

With that in mind and also to wash, size and segregate the gravel for subsequent use in mixing concrete for the new structures, Webb & Knapp acquired 110 acres of land 6 miles northwest of the building site. Included in the purchase was a plant suitable for processing the gravel, as well as perpetual rights

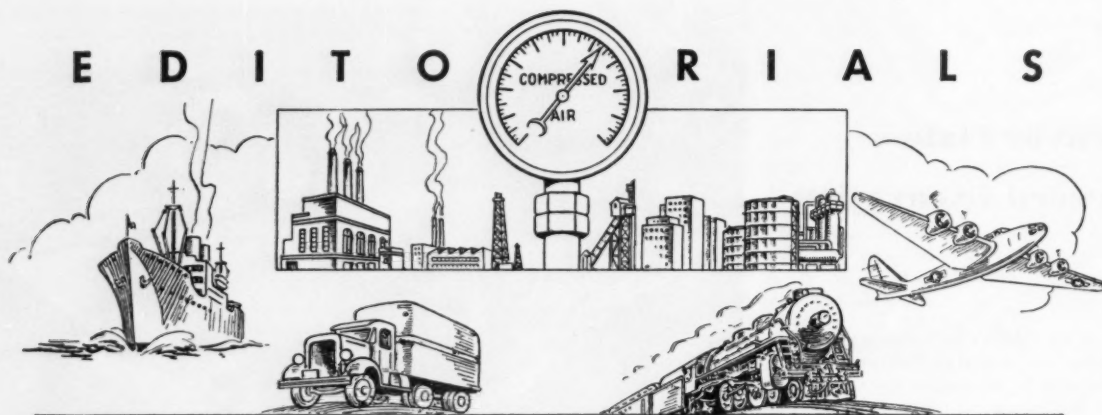
to a stipulated volume of water from Clear Creek. After the property has served its initial purpose, Webb & Knapp proposes to develop a residential community there with several artificial lakes to add to its desirability.

As little or no solid rock has to be cleared away, the job is primarily one of digging and hauling. For holding breast boards to retain the side walls, steel piling was driven at intervals of 6 feet around the site. Removal of material proceeded without complications until ground water was struck at a depth of 30 feet. To handle it, a series of sump boxes was installed, each being located in an excavation dug within an area enclosed by steel piling forming a square 18 feet on a side. Each sump box is 12 feet square and from 20 to 32 feet high, is made of fir planks with 1-inch spacing between them and the whole is wrapped with galvanized wire. Weight of the units runs as high as 18 tons each.

Before a box was put in position a test column was inserted in the excavation and loaded with up to 120 tons to ascertain the bearing capacity of the ground. When a test was completed the column was withdrawn, the sump box put in place and the space between it and the steel sheeting filled with crushed stone through which water would percolate. The piling was then pulled. Water is pumped from these sumps to lower the ground level as digging proceeds.

To accommodate sidewalk superintendents, peepholes were provided at three different levels in the fence surrounding the site and stands built at several good vantage points.

E D I T O R I A L S



TIME AND TIDE

GEOLOGISTS deal in big blocks of time. The traditional threescore years and ten of man's supposed stay on earth is to a geological period what the second-tick of a watch is to a century. Even a geological survey consumes a lot of time if there is much territory to cover. We are told, for example, that the Department of Mines of Canada's Quebec Province is just getting well started on a survey of the province's 600,000 square miles after more than a half-century of work. It will not be finished with the job for perhaps another 150 years.

Aerial methods are of little help in this sort of survey. The work is done with instruments by plodding men who must comb the ground thoroughly no matter what the nature of the terrain. Field operations are confined chiefly to summer, both because the ground has to be examined when it is not blanketed by snow and because most of the manpower is necessarily recruited from the staffs of colleges that are closed at that season. It is difficult to hire consulting geologists, as they prefer the higher pay that comes from private practice in the mining and petroleum industries.

During the summer just past, about 150 trained men and their helpers took to the field. This was almost a record number. They covered approximately 4000 square miles of land in their search for indications of minerals ranging from asbestos to zirconium with, of course, considerable attention given to uranium. The parties stay out five months or less. Then their findings must be recorded, interpretations made and maps drawn.

The work has much practical significance. Mining literature is full of accounts of profitable, even rich, strikes by prospectors who gained their first clues from casual references to mineralization in the report of a geologist or an explorer or missionary priest with a smattering of geological knowledge. To cite one recent example, the fabulous iron-ore deposits of Labrador that are now being exploited first became known

through maps of the area prepared by The Rev. Louis Babel during trips he made in 1866-70. The crude sketches induced Dr. A. P. Low of the Geological Survey of Canada to spend the summer of 1894 there making topographical and geological surveys. His charts, drawn to a scale of 25 miles to the inch, were, in turn, used by an exploratory party that discovered iron outcroppings in 1929. From there on events moved rather fast, and a mining operation that cost \$200 million to set up is now in full swing in that region.

JOE COLLEGE — 1955

THIS is the season when Young America is settling down to another school year. All over the country new crops of freshmen are getting their first taste of college life. What are college boys like today? How have changing world conditions affected their thinking and actions? Are these lads different from their counterparts of, say, 1940?

According to Dr. Glen T. Nygreen, now dean of men at Kent State University in Ohio and previously for a long time staff counselor in the office of the dean of students at the University of Washington in Seattle, Joe College has changed a lot since prewar days. He calls the present young campus dwellers the finest and most responsible ones he has ever seen. One thing they have mastered is what he terms the "ability to handle the certainty of uncertainty." Prewar students were reluctant to try to think ahead and plan their lives because they knew they might be called into military service. Today's students know they will have to give over at least two years to this duty. It has been a part of their thinking since high-school days, so they accept it and it doesn't disconcert them.

Another noteworthy change reported is a greater tendency to put academic work ahead of campus activities. Current collegians are said to be less eager to distinguish themselves as leaders of student affairs if their classwork might suffer thereby. Dean Nygreen states

that they are "better masters of their time." It is no longer necessary, he says, to remind them that it is a privilege to attend a university. They realize the opportunities offered them and are out to make the best of them. Possibly affecting this attitude is the fact that 25 percent of the college men are now married, as compared with 6.7 percent in 1941.

Increasing numbers of students evince a desire to equip themselves for serving society in some way and do not expect to make a lot of money. Tangible evidence of this sort of thinking is the fact that it is not uncommon nowadays for boys to relinquish scholarship awards after getting after-class jobs that enable them to support themselves. Dean Nygreen cites three such instances where students each gave up \$500 a year. One of them had a wife and three children, but was getting along by working a night shift in an airplane factory. In each case the boy suggested that the award be given to someone who needed it more than he did.

Another characteristic noted in the modern collegian is a longing for participation in social groups. Reflecting this trend, memberships in churches, fraternities and coöperatives are higher than they used to be. Incidentally, we are assured that fraternities have calmed down, dropped their traditional hazing practices and that "a more educational attitude permeates the houses."

On the other hand, they are suspicious of mass movements, apparently remembering that some of these were tinged with radicalism in the past. Even the nonpolitical National Students' Association which the Department of State sponsors as a vehicle for student expression on international relations has not been well accepted. Today's collegians are so taciturn as to be called "the silent generation," but Dean Nygreen says they do plenty of sound thinking on world affairs.

In a few words, Joe College seems to be less of a cutup and more of a student than either his father or his grandfather.

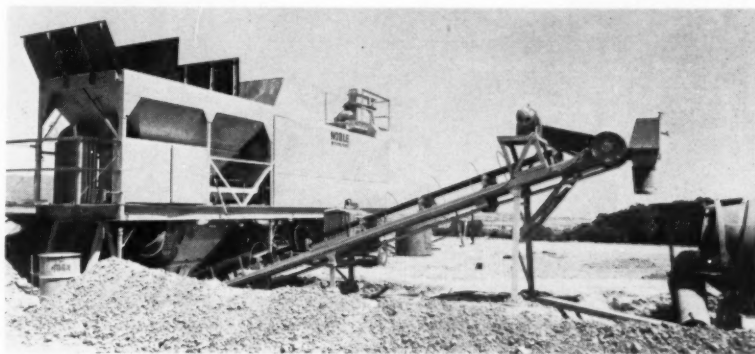
Mobile Concrete Batching Plant

A PORTABLE concrete batching plant that can prepare 60 cubic yards per hour is being made by Noble Company, of Oakland, Calif. The complete unit is mounted on a Fruehauf tractor-trailer and is within legal weight and size limits for travel on the highways of most states.

The assembly includes a 3-compartment aggregate bin with a capacity of 28 tons that can be increased to 80 tons, a 1000-cubic-foot cement bin and a 2-yard batcher. Aggregates and cement are loaded into the bins by a clamshell bucket, scooploaders or a conveyor belt. The batched aggregates and cement are transferred to a mixer by an elevator conveyor that is moved from job to job on a flatbed truck or trailer.

Compressed air is used at several stages in the operations. At low pressure, it aerates the cement so that it can be easily handled and accurately regulated. At 90 psi it actuates four rams that open and close gates controlling the flow of aggregates and cement during the automatic weigh-batching cycle. The air is supplied by an Ingersoll-Rand motor-driven compressor mounted on the trailer with an 80-gallon storage tank.

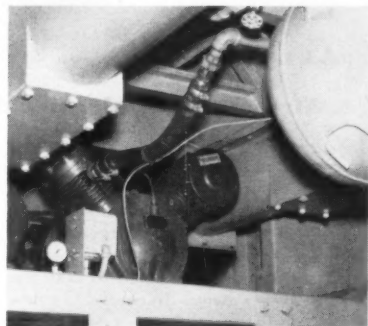
The plants are used mainly by small



IN SERVICE

A Noble mobile batching plant shown on a large housing project in northern California. Weighed batches of aggregates and cement are transported by an elevator conveyor to a 2-cubic yard mixer. The view at the bottom shows the air compressor mounted on the rig and connected with its receiver. The air fluffs the cement for easy handling and operates gates on the bins.

contractors on housing developments and construction projects where they obviate the need of obtaining transit-mix concrete.



Safety Handle Saves the Knuckles

A PAVING breaker with a handle that will protect the operator's hands from injury is being offered by Ingersoll-Rand Company. As the hands grip the conventional bar-type handle, they rest inside aluminum guards that prevent them from coming in contact with any wall or other external object.



The safety device weighs less than 2 pounds.

There has long been a demand for something of this sort because paving breakers are often used close to walls or projecting masonry where a slip or a jar may result in skinned knuckles. The steel industry, which is keenly safety-conscious, has been aware of this need for some time.

As a part of their safety programs, the steel mills of the Pittsburgh district have checked paving-breaker accidents along with others. While these have normally not been serious enough to entail loss of working time, most of them have necessitated medical treatment.

Only bruised or skinned knuckles or fingers were usually reported, but occasionally there have been broken bones. On the financial side, it has been found that the average paving-breaker injury, including treatment, paper work and incidentals, costs from \$120 to \$160.

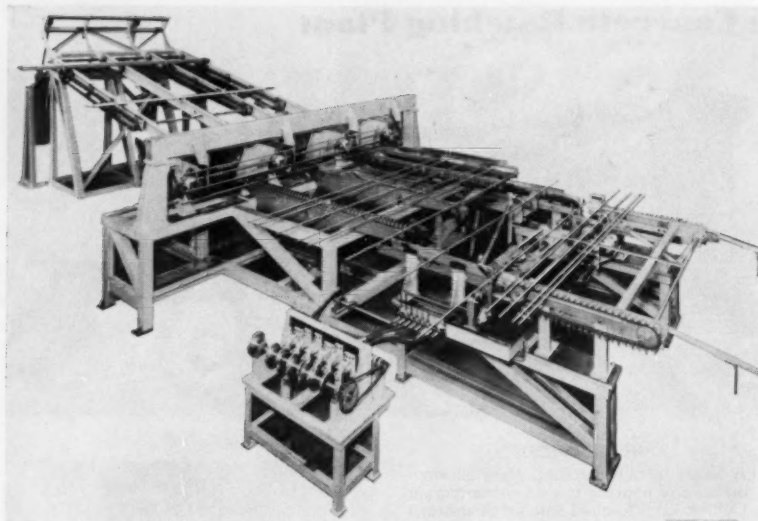
As an outgrowth of discussions at safety meetings, some of the mills attempted to develop a suitable handle guard for their own use, but in this they were not entirely successful. Ingersoll-Rand then produced one which, upon testing under service conditions, proved to be satisfactory. It is now available mounted on the company's new PB-8A paving breaker.

Long Tunnel Lined with Plastic

SHEET plastic has been used by contractors to line cast-in-place concrete in tunneling operations, but not on the scale as in the La Cienega-San Fernando Valley relief sewer. That conduit is 1¼ miles long, 8¼ feet in diameter, and involved both open-cut and tunnel work. With the exception of the invert, it is protected throughout with Amer-Plate T-Lock polyvinyl-chloride plastic.

First the sheet material and then steel reinforcing was placed on top of the collapsible forms used to pour the 12-inch-

thick semielliptical arch, as well as on prebuilt transition and other special sections. During concreting, the forms were vibrated by clamp-on air-operated vibrators so as to embed the Amer-Plate's T-shaped ribbing, spaced on 2½-inch centers, in the concrete and thus make the plastic an integral part of it. Because of its length and the fact that the volume of the flow will normally not fill the conduit, the plastic lining was specified to protect the concrete from damage by sewer gas.



Air-Controlled Machine Automatically Feeds Forge

IN THE manufacture of large coil springs, one end of each rod blank is given a taper or point prior to being formed or wound. The job customarily calls for a large force of forgers and helpers, as well as additional men to bring the work to them and to take the finished pieces away. In contrast, a new machine of the automation type enables one operator to turn out hourly 618 finished rods $\frac{3}{4}$ inch in diameter and 12 feet long. For the most part a conveying mechanism, the equipment is controlled by air cylinders because they are not affected by the high temperatures necessary in such operations.

Reference to the accompanying illustration will help to explain how the machine works. Bar stock, fed from a conveyor cradle at the left, is dumped onto a ramp by two hydraulic cylinders and carried by a mechanical chain conveyor to a selector which passes the rods to a helicoidal screw conveyor, one being placed in each axial thread length. The selector is controlled by an air cylinder. The screw conveyor is arranged so that one end of each bar extends into a stand-

ard heating furnace and is timed so that the rod reaches a temperature of 1900°F at the end of its travel. Upon leaving the screws the stock is picked up by a straight-line conveyor, powered by a pneumatic cylinder, which transports it to the forging or pointing station.

At the forging station the rod is positioned on a reciprocating cradle by a "paddle" gauge or travel-limiting device actuated by an air cylinder and held in place by a pneumatic diaphragm clamp. Still another air cylinder moves the cradle into forging position, where the rod end meets the dies, and then retracts the rod to a point where squeezing dies are brought into play. The latter cycle is repeated twice more, and at the last squeeze a pneumatic cylinder pushes the rod up so that when the dies come together the part number of the finished coil spring is coined in the metal. After the triple operation the rod is deposited by means of an air motor-powered cam on a chain conveyor which travels at a speed that allows ample time for cooling the finished work.

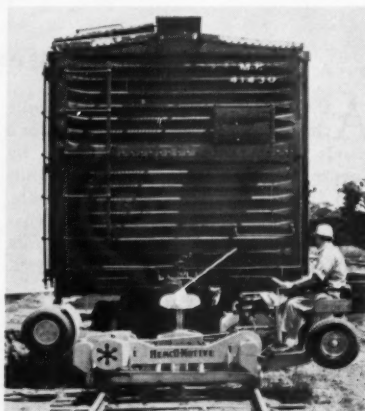
Circle 1E on reply card

Diminutive Switcher

THOUGH small, the Hemco-Motive, a 1-man tractor, is said to switch and move railway cars of all types. Without leaving his seat, which is offset far enough so that he can see the entire length of a train, the operator can spot the machine on the track, retract pneumatic-tired wheels to lower it onto a set of rail wheels and couple it to a freight car.

The tractor coupling is mounted on a hydraulic ram which is actuated after coupling to transfer part of the car weight to the tractor, thus increasing the latter's traction. It has a maximum effective drawbar pull of 7400 pounds and is driven by a Wisconsin gasoline engine. The unit's dimensions are within those specified for standard railroad clearances, and it will handle cars as well on switches, crossovers and the sharpest of curves as on straight sections.

Built by Hemco Manufacturing, Inc., the machine includes such features as fluid drive to eliminate shocks to cars and itself, conventional electric ignition and starter and sealed-beam headlights on both ends. Track sanding equipment for adverse conditions is also available. The tractor has a maximum speed of 1.5 miles an hour on rails and 12 miles on rubber wheels.



Circle 2E on reply card

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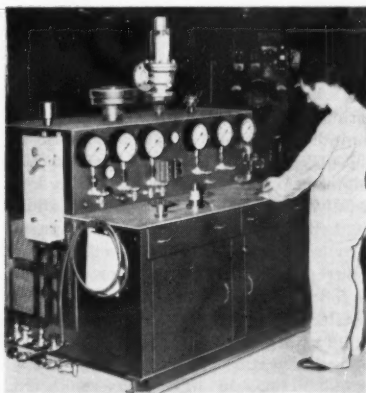
Circle 16A on reply card

Industrial Notes

An improved line of Dri-Stat dry-process equipment for photo-copying correspondence, orders, invoices and other typed or drawn originals has been announced by Peerless Photo Products, Inc. It includes a redesigned combination printer and processor, a new flat-bed printer designed especially for copying from books, and Bright-Light paper that is said to give exceptionally good results under normal office light.

Circle 3E on reply card

Shown here is a standardized, skid-mounted valve testing station which sells for about one-third the cost of the average installation custom built in plants. The unit comes complete with a compressor and an air-powered hydraulic booster providing pressures up to 6000 psi and, through the medium of adapters, permits testing 97 percent of all globe, gate, safety and relief valves and plug cocks. An integral air receiver has sufficient capacity for checking the setting and capacity of all safety valves. Acces-

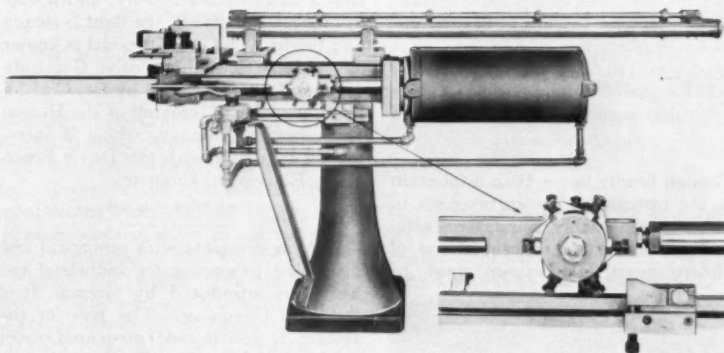


sory equipment includes spools, gaskets, wrenches, gauges, C-clamps for mounting, etc. The four test outlets are on top of the station: the one on the left is for hydraulic (water) testing between 10 and 6000 psi and for air testing between 500 and 6000 psi; the others are for air checks ranging up to 500 psi, the working pressure of the compressor. Large valves can be tested out on the floor. The unit is built by Farris Engineering Corporation.

Circle 4E on reply card

It is reported that down time for cleaning concrete-handling equipment is shortened by giving it a plastic coating to which concrete does not adhere. The finish is called Epoxyn Crete-Free and comes in clear form for application over paint and in colors for resurfacing old or covering new equipment. It is a product of Co-Polymer Chemicals, Inc.

Circle 5E on reply card



By means of a turret attachment designed by Paul Machine Tool Company for its air-operated Bend-Ex-Bender it has increased the capacity of that machine and simplified its operation, according to a recent announcement. The standard unit has six stations any or all of which are set manually at the start to give round tubing, channels or solid bars the desired number of angle bends. After that the machine functions

automatically. On the return stroke of the tube rack a ratchet engages an index finger and advances the turret to the next position, and so on until the cycle is completed. Turns are adjustable longitudinally on the rack to accommodate different setups, and the index-finger unit is demountable for hand operation. The turret is easily attached to existing machines.

Circle 6E on reply card



Simplify Your Coal Storage with a

ONE MAN

SAUERMAN MACHINE



Here's how a Sauerman machine solves two of your biggest coal storage problems . . .

- ✓ PROTECTS AGAINST SPONTANEOUS COMBUSTION . . . "Layers-in" the coal to prevent voids which form dangerous air-pockets or flues.
- ✓ PROMOTES BETTER LABOR RELATIONS . . . Operator is in safe, comfortable position overlooking the work area. A satisfied employee eliminates "FLOATING LABOR".

The drag scraper method is the economical way to handle coal. No heavy equipment moves through the pile, only the Crescent scraper bucket contacts the coal. This reduces power requirements and keeps maintenance costs at a minimum, since no highly machined parts travel the storage area. One man, in a safe location, controls the entire operation, whether it be 20 or 600 cu. yds. per hour.

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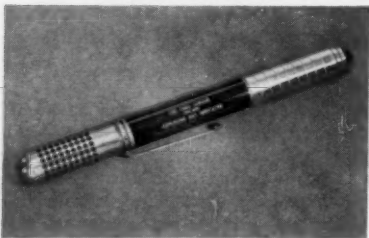
Circle 17A on reply card



Alumblack is a new cold chemical that gives aluminum a dull or high-gloss smooth finish, depending upon whether it remains unrubbed or is polished. Having a low surface tension, it can be applied by brush or rag, dipping or spraying and is said to dry in a minute. Birchwood Chemical Company, which makes the coating, is offering sample kits.

Circle 7E on reply card

Though hardly larger than a fountain pen, the instrument shown promises to contribute measurably to industrial safety where dangerous concentrations of explosive gases and vapors must be



guarded against. It is operated by two small replaceable batteries and permits making quick spot checks simply by removing the indicator from its plastic case and depressing a light bulb, which acts as a switch. The bulb glows dimly when the switch is on. If there is a

trace of combustible gas or vapor in the atmosphere the light begins to flash intermittently; with increasing concentration it flashes more rapidly; and if conditions are hazardous, the light is steady and bright. The pocket model is known as the Page Sensor Explosive Gas Indicator and was developed by Dr. Carl M. Page, director of research of the Hogart Engineering Company, which is introducing it jointly with the Davis Emergency Equipment Company.

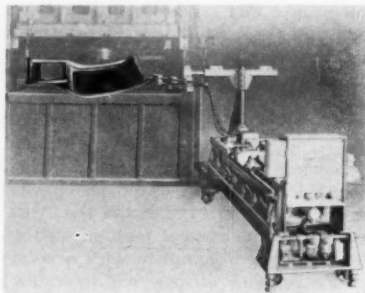
Circle 8E on reply card

Roofing complete with acoustical and insulating properties for industrial use has been introduced by Granco Steel Products Company. The base of the system is galvanized corrugated sheet steel with closely spaced holes $\frac{5}{32}$ inch in diameter. On top of it is laid first a phenolic mat and then a 1-inch thick batt of fiberglas or sound-absorbing material. Over this is poured a layer of lightweight concrete, generally around $2\frac{1}{2}$ inches thick, reinforced with wire mesh. The entire assembly weighs less than 8 pounds per square foot and is given a finish coat of tar and gravel.

Circle 9E on reply card

To its line of automatic handling equipment for die-press and stamping operations, Hamilton Automation, Inc., has added an air-powered mobile press

hand that can be set to function at a maximum rate of 30 strokes per minute. The unit is controlled by two switches and uses 110-volt current. In service, the hand reaches into the machine, grabs the work, and then retracts, firmly holding the part under pressure while the arm support moves back on its sliding



track. At the end of the stroke, the hand releases the work and the support starts forward again to repeat the cycle. The equipment comes in three sizes with a 24-, 36-, or 48-inch stroke.

Circle 10E on reply card

Air leaks in boilers can be detected in a minimum of downtime, it is claimed, by a method that has reportedly saved New York Consolidated Edison Company an estimated \$100,000 annually in fuel and maintenance costs. It was conceived by the utility's assistant chief performance engineer and consists in introducing Pydraul F-9, a fire-resistant hydraulic fuel made by Monsanto Chemical Company, into a boiler by means of a Todd industrial fog applicator. The procedure is as follows: After the boiler is thoroughly bottled up, forced draft is admitted to build up a furnace pressure of 0.3 to 0.5 inches of water. Then the fogging machine is brought into action to break down the hydraulic fluid into tiny flotation droplets which enter the boiler by

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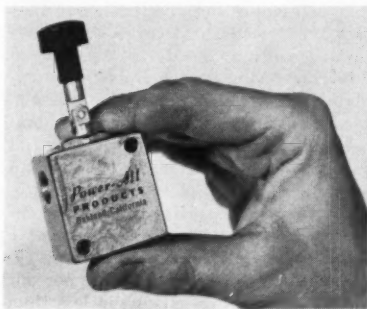


"It's a coffee break, really — broke it falling downstairs going to the coffee shop."

way of a hose inserted through an access door or other opening. In the case of pressurized boilers the line is connected to a 4½-inch gate valve. The fog searches out all leaks, and as it issues from them in visible streams they are marked on the exterior walls. According to Todd Shipyard Corporation, which cooperated with Consolidated Edison in devising the applicator, it can be used to detect leakage in turbines and condensers when the turbines can be sealed at the shaft.

Circle 11E on reply card

Compact and of rugged construction, the ¼-inch pneumatic shut-off valve shown is said to offer advantages especially in connection with multiple air setups. Made by Power-All Products, the



HV-250 is designed for pressures up to 150 psi and permits the passage of 52 cfm at 100 psi. It can be used normally off or on and can be mounted horizontally, vertically or with a pipe nipple only. The valve will soon be available also in ⅛- and ⅜-inch port sizes.

Circle 12E on reply card

To simplify the job of identifying metal bars, sheets, etc., in plants and warehouses, Zaco Laboratories is marketing a quick-drying coding lacquer put up in a pressurized container. Called



"I got a feeling we're moving the wrong field office."

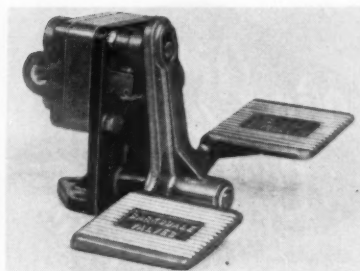
Zip Spray, it comes in twelve colors so stock can be marked according to temper, gauge, pickle, alloy or other distinguishing characteristic.

Circle 13E on reply card

What is claimed to be a revolutionary variable-speed a-c motor is to be built in the United States by Bogue Electric Manufacturing Company under a license from Laurence, Scott & Electromotors, Ltd., England, which brought the unit to its present stage after initial development on the continent. In the Type N-S all gears and mechanical means of power transmission have been eliminated and replaced by electric controls ranging from manually operated to semiautomatic and automatic. Units from 0.5 to 1000 hp with a speed range of 30:1 to 1.5:1 will be available. They are designed to operate on 3-phase a-c current of 50, 60 or 400 cycles.

Circle 14E on reply card

Barksdale is offering a new 4-way foot-controlled air valve—Model 2800—that incorporates its Shear-Seal principle or pressure-balanced self-aligning brass valve seat which is continually in contact with a bronze rotor containing the flow passages. Operating the valve "shears" the flow, and the square external corner of the seal face wipes the rotor, cleaning it. The unit is designed



for pressures up to 250 psi and can be set for spring return to either end or the center or for nonspring return. Any port may be used as the pressure port, and the body can be rotated in 90° increments for most convenient piping. Of low cost, the Model 2800 is available in ¼-inch and ⅜-inch port sizes.

Circle 15E on reply card

Hot by-product salt is being carried from a drier to storage in a chemical plant by an elevator belt equipped with Monel buckets and covered with Hypalon, a new Du Pont product in its line of elastomeric materials. In this grueling service, in which the conveyor is exposed to a maximum temperature of 500°F (average 300°), it lasted more than twice as long it is claimed as earlier belts, which failed in from two to three months. In addition to conveyors of this type, the



A COMPLETE LINE OF AIR CONTROL EQUIPMENT

Including precision-made **HEAVY-DUTY**

AIR MOTORS

WITH "SEALED-IN LUBRICATION" Pat. Pend.

Wide choice of electric and/or air controls and mountings. For air pressures up to 200 P.S.I. Bores: 1½"-2"-3"-4"-5". Stroke: ½" to 72".



"Sealed-in Lubrication"
Assures low break-away on long idle units — ample sealed-in oil for thousands of cycles without attention.

"Sealed-in Lubrication"



AIR CYLINDERS
1½" to 8" bore

3 or 4-Way
AIR POWERED VALVES



Air or electrically operated.

Lehigh Minor AIR VALVES and CYLINDERS



Low priced, light duty. For air operated jigs, fixtures, high speed operations.

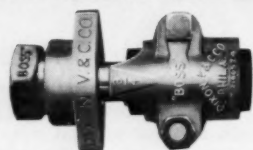
You Are Invited To Consult Our Engineering Department
freely on all air automation or replacement problems. Trained factory personnel available nationally.

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Circle 19A on reply card



"GJ-BOSS" GROUND JOINT AIR HAMMER COUPLING

The strongest and most efficient coupling for every type of air and pneumatic hose... and it requires no washer to keep it leak-proof. Ground joint design provides a perfect soft-to-hard metal seal between end of stem and spud that is not affected by grit or dirt. Extra gripping power is assured by the superstrong "Boss" Clamp, with heavily reinforced extensions to engage collar on coupling stem. Compact Style, $\frac{1}{2}$ " and $\frac{3}{4}$ ". Heavy Style, $\frac{3}{4}$ " and 1". Cadmium plated—rustproof.



"No. 3500" STEEL NIPPLE

A quality nipple that does a real coupling job inexpensively. Machined from cold drawn steel bar, with large-capacity bore and deeply corrugated, smoothly finished shanks. Collar back of hex portion engages extended anchoring fingers of "Boss" or "Air King" Clamps. Hose sizes from $\frac{1}{4}$ " to 1", in various hose and I.P.T. size combinations. Cadmium plated—rustproof.

Stocked by Manufacturers and Distributors of Industrial Rubber Products

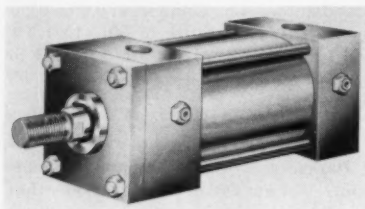


Circle 20A on reply card
(314)

chemical rubber is available in the form of sheet packing and gasketing and is also showing promise in field trials as a covering for wire and steam hose and for countless other uses where resistance to heat, ozone, chemicals and the elements is required.

Circle 16E on reply card

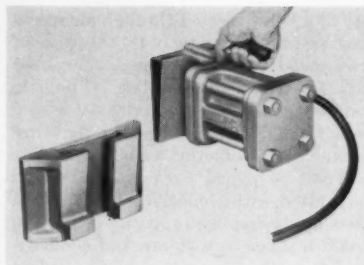
A new line of air cylinders of square-end design to save space has been announced by The S-P Manufacturing Corporation. The units are available with either single or double rod ends in eleven bore sizes from $1\frac{1}{2}$ inches through 14 inches and with 21 types of mountings. They feature brass tubes, a removable



bronze cartridge containing wiper and rod packing, and cold-rolled steel end plates. On cushioned models, the cushions float on an O-ring for accurate self-alignment.

Circle 17E on reply card

For heavy-duty service that does not require a permanent vibrator installation, The Cleveland Vibrator Company has announced a well-balanced pneumatic model of light weight. Designated the Type LSRRH, it develops 7000 to



Circle 18E on reply card

8000 vibrations per minute at maximum efficiency and is suitable for use in connection with portable bins, trucks, concrete forms, septic tanks, etc. It is easily attached by means of sturdy cast-steel brackets.

A high-speed radiation detector that acts five times faster than existing models has been announced by the Industrial Division of Minneapolis-Honeywell Regulator Company, Philadelphia 44, Pa. It is especially suited for measuring temperatures of fast-moving bars, billets and sheets which are "on target" for less than a second and for applications where profile measurements determine temperature distribution along a traveling slab, strip or sheet. The new Radiamatic pyrometer is said to respond to 98 percent of any temperature change in less than half a second.

A sandblast room that can be shifted to another location if desired has been designed by Vacu-Blast Company, Inc. Instead of the customary large hopper mounted in a pit for automatic abrasive



"I had to leave my last job because of illness. I was sick of working."

return, it features a waffle floor that is assembled of numerous small hoppers and extends 6 $\frac{3}{4}$ inches above floor level. No excavating is required. Like the machinery and building in which it is housed, the floor can be unbolted for removal. The ventilating air (down-draft) serves two purposes: to ventilate the chamber and to recirculate the abrasive. Screw conveyors or bucket elevators are not required.

Circle 19E on reply card

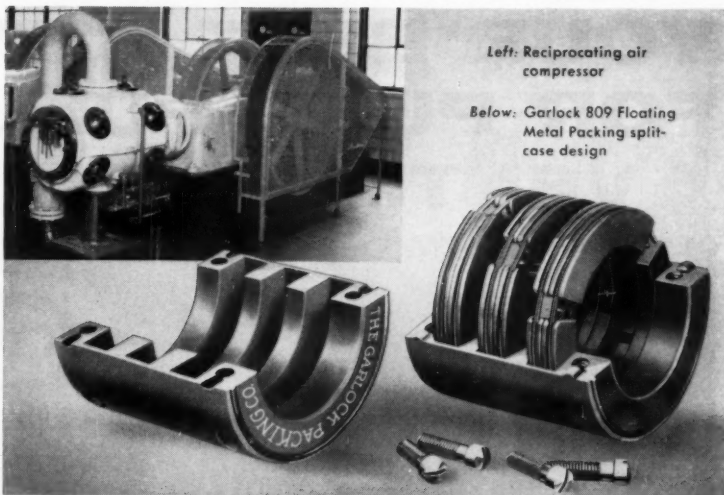
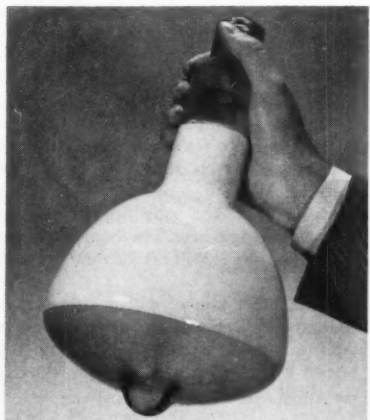
For service where a regular flat-topped belt conveyor would be ineffective, Goodyear Tire & Rubber Company has designed a cleated belt that will carry small parts and packages up a grade of



30 percent and more. The cleats are made of rubber and range in height from $\frac{3}{8}$ inch to 1 $\frac{1}{2}$ inches. The belting is now in production and is available in varying plies, cover thicknesses, widths and rubber compounds to meet different needs.

Circle 20E on reply card

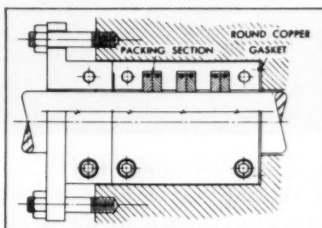
For industrial use, especially in dirt-laden atmospheres, Westinghouse is offering a new 400-watt fluorescent-mercury lamp of the semireflector type designated as P-H1. It has a mogul screw base and the inner wall of the reflector bulb has a phosphor coating that provides a golden-white light and directs about two-thirds of the lumens downward. The remaining third is radiated upward, or can be redirected on the



Left: Reciprocating air compressor

Below: Garlock 809 Floating Metal Packing split-case design

For air compressors, users report **GARLOCK SPLIT-CASE METAL PACKINGS** have 2 big advantages



1. **LONG, TROUBLE-FREE LIFE.**
Minimum of 7 years with proper lubrication.
2. **CAN BE INSTALLED WITHOUT DISCONNECTING THE ROD.**
Downtime is reduced to a minimum.

You can eliminate the cost of frequent packing replacements and unnecessary downtime by installing Garlock split-case metal packings on your reciprocating air compressors. Service reports show that these Garlock metal packings have given 15 years and more of trouble free service with a minimum of rod wear.

For complete information, call your Garlock representative or write today for Brochure 3889.

THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.

Sales Offices and Warehouses: Baltimore, Birmingham, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Houston, Los Angeles, New Orleans, New York City, Palmyra (N.Y.), Philadelphia, Pittsburgh, Portland (Ore.), Salt Lake City, San Francisco, St. Louis, Seattle, Spokane, Tulsa

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GARLOCK

**PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS, RUBBER EXPANSION JOINTS**

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YOUR BEST BET FOR PUSH-PULL VENTILATION



In underground construction, Naylor offers the most practical push-pull ventilating service.

The combination of light-weight Naylor Spiralweld pipe and the Naylor low pressure Wedge-Lock coupling provides a system with these outstanding performance advantages.

Lines can be made up quickly — faster than by any other method. The coupling provides remarkable accessibility. Space on only one side of the pipe is required for connection. The compact design of this coupling method permits the line to hug the walls in tunnels or wherever space is limited. With each joint of pipe the same length, it is a simple matter to replace any section at any time.

For the complete story, ask for Bulletins No. 507 and No. 514.



1245 East 92nd Street, Chicago 19, Illinois

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Circle 22A on reply card

work below by a reflector. The new lamp has an initial output of 19,000 lumens and has a rated average service life of 6000 hours. It can be burned in any position and can be installed in most fixtures for 400-watt mercury lamps.

Circle 21E on reply card

QUOTES

—FROM HERE AND THERE

No More "Hot Boxes"

"A potent new weapon in the railroad industry's perennial war on 'hot boxes,' the cause of many costly freight train delays and derailments, has made its appearance on a number of major railroads.

"Developed by National Motor Bearing Company of Redwood City, Calif., the elements of the system comprise four principal devices that are installed in the journal boxes as they now exist. First is a circular and dirt-tight seal at the inside end of the journal. This is matched with an equally tight seal on the lid of the journal box at the outer end. Inserted within the box itself are . . . a rocking oil circulator on the base of the box which keeps oil bathing the axle end whenever the axle is turning even slightly and a guard bearing which reduces or eliminates contact of the axle end or journal with the box itself due to forward-and-back movement of the axle.

"With the axle end or journal rotating within a box . . . the company claims elimination of 81.4 per cent of all hot boxes in extensive tests. Oil consumption was reduced 90 per cent, along with a like cut in inspection time, and accidents caused by hot boxes were practically eliminated."

New York Herald-Tribune,
September 7

Shovel with 100-ton Lift

"The nation's biggest coal producing company expects to begin operating history's largest power shovel late this year at a strip mining operation in Ohio. The 12-story high power-machine now is being assembled at Pittsburgh Consolidation Coal Co's Georgetown works near Cadiz.

"The coal company designed the machine, hoping to reach coal reserves deep in the earth which cannot be mined economically by present methods. The shovel is built to scoop up 100 tons of earth in a single lift. The biggest shovel now in existence will lift 72 tons of earth at once.

"The super shovel will not do actual coal digging. Its purpose is to move mountains of earth covering deeply buried seams of coal. Smaller shovels then will mine the coal."

The Technocrat, September

Industrial Books, Films and Literature

The U. S. Department of the Interior, Bureau of Reclamation, has issued the sixth edition of the *Concrete Manual*, a volume of 491 pages detailing the best practices in the making, handling, placement and protection of concrete as determined by the Engineering Laboratories of the Bureau in Denver, Colo. The new edition reflects the important changes that have taken place in concrete technology since 1949, the previous publication date. It is obtainable from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., or from the Bureau of Reclamation, Denver Federal Center, Denver, Colo., Attention 841. Price \$2.50.

How a single steam humidifier installation can take care of small-room (12,000 to 90,000 cubic feet) humidification problems is explained in Bulletin No. 501 available from Armstrong Machine Works.

Circle 22E on reply card

Technical Data Book U-333, a reference manual on the uses and applications of flexible metal-hose products is offered by Universal Metal Hose Company to purchasing agents and engineering and maintenance personnel.

Circle 23E on reply card

In a new brochure Tapecoat Company sets forth the characteristics of Tapecoat-X and the economies that can be effected by safeguarding pipe, pipe joints, fittings and couplings with this extra-thick coal-tar coating.

Circle 24E on reply card

Bulletin 500, obtainable from S.P. Kinney Engineers, Inc., covers the firm's line of automatic, manual and twin basket strainers for removing fine suspended particles from raw or process water, oil, gasoline, alcohol, white water, ammoniacal liquor and many other liquids.

Circle 25E on reply card

The selection of constant-speed Texrope V-belt drives is made easy by multicolor tables in a 72-page booklet, 20-P40, offered by Allis-Chalmers Manufacturing Company. It also contains information on design features, basic drive principles and technical data on sheaves.

Circle 26E on reply card

Useful tips for pyrometer users have been compiled by Wheelco Instruments Division, Barber-Colman Company, in Bulletin F 7259. It represents an accumulation of information gained by its service organization and should be of help in keeping these instruments in perfect operating condition.

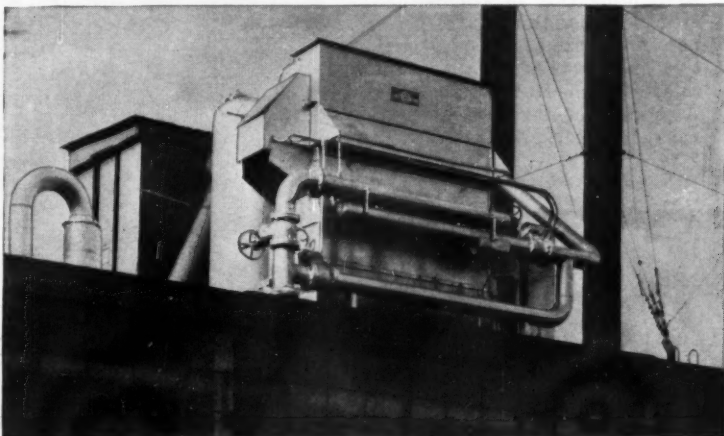
Circle 27E on reply card

The best methods of keeping water-using equipment clean are discussed in a 6-page folder being distributed by Hall Laboratories, Inc., a firm of engineers in industrial water problems. Trouble spots which can cause failures and shutdowns are pointed out to make management conscious of the millions spent annually on repairs and maintenance.

Circle 28E on reply card

Ingersoll-Rand Company offers free of charge a 30-minute, 16-mm sound-color film entitled *The Long Street* which deals with superhighway construction. A professional production, it tells the story of a small-town druggist who is opposed to the building of a

**Direct saving of cooling water expense returns to you
the cost of a Niagara Aero After Cooler
in less than two years.**



How to Get Drier Compressed Air:

***It prevents many troubles and saves
much expense***

● **NIAGARA AERO AFTER COOLER** cools compressed air or gas below the temperature of the surrounding atmosphere. Therefore you get no further condensation in your lines. You save much in repairs to pneumatic tools and equipment; you save much interruption to production; you save water damage in paint spraying, in air cleaning, in any process where compressed air comes in contact with your materials or parts in manufacturing (sand blasting, for example).

Niagara Aero After Cooler uses evaporative cooling, saving 95% of your cooling water con-

sumption. This saving quickly returns the cost of the equipment to the owner or makes extra cooling water available for other processes.

The Niagara Aero After Cooler produces compressed air with 30% to 50% less moisture than by ordinary cooling methods. Other Niagara equipment provides bone-dry air for processes requiring it.

If you have an air problem or a cooling problem, a Niagara engineer probably has an answer that will improve your process or save you operating or maintenance expense.

Write for Bulletin 130

NIAGARA BLOWER COMPANY

Over 35 Years Service in Industrial Air Engineering

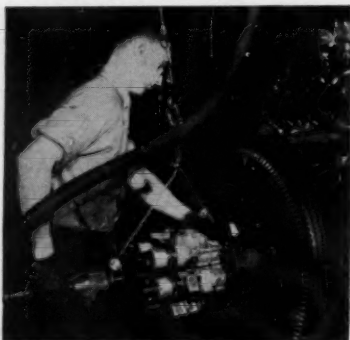
Dept. CA, 405 Lexington Ave.

New York 17, N. Y.

Experienced District Engineers in all Principal Cities

Circle 23A on reply card

Nickel Cast Iron cylinders provide desired properties to keep air-powered tools, like this one, on the job. Less maintenance and non-productive labor costs add to the worth of this 10-Spindle Multiple Nut Runner. A product of Ingersoll-Rand Company, New York, N. Y.



Get Better Quality Control by simultaneous running of nuts. No experience needed for controlling torque to meet specifications, when you use an I-R Multiple Nut Runner. Here's one in use, assembling wheels to axles.

I-R Multiple Nut Runner
by-passes press operation



Dense, long-wearing Nickel Cast Iron assures trouble-free performance of air motor cylinders

Here is where nickel cast iron renders help . . .

Where a large auto manufacturer by-passed an operation that required two $\frac{1}{4}$ ton presses.

Heretofore, the presses positioned a differential carrier in the rear axle housing. Ten $\frac{3}{8}$ " nuts were then run on individually. But only skilled workers could draw them to meet the torque specified.

Today, the carriers are hand set to within $\frac{1}{8}$ " of the ultimate location, and then quickly drawn into position by the Multiple Nut

Runner, which runs all 10 nuts at once.

Meets 5 Cylinder Essentials

In running ten nuts at a crack . . . all to exact torque . . . nickel alloy cast iron plays a vital role. This alloy cast iron was especially chosen, to meet five basic needs of air motor cylinders:

- Air-tight density**
- Strength to meet sudden stresses**
- Resistance to wear**
- Good response to heat treating**
- Machinable throughout**

It's one more instance that shows you how alloys containing nickel . . . alone or along with other alloying elements . . . can solve hard problems. For the properties of alloys containing nickel may be controlled to meet almost any fabricating and service demands.

We'll be glad to help you choose the right nickel alloy to improve performance of your products or equipment. Let us have details of your problem. We'll go over them and send you our suggestions.



THE INTERNATIONAL NICKEL COMPANY, INC. 67 Wall Street
New York 5, N.Y.

throughway near his community. Through his eyes the viewer sees compressors in action operating rock drills and other pneumatic tools — in short, how contractors now tackle the big job of rock removal. The picture is distributed by the Film Service Department, Ingersoll-Rand Company, in Phillipsburg, N. J.

A 23x33-inch wall chart on the proper selection and upkeep of belting is offered to conveyor users by Hewitt-Robins, Inc. Belt storage, correct design of loading chutes, use of automatic switches, lubrication, inspection and other aspects of maintenance are dealt with and types of belts best suited for different industrial applications are listed.

Circle 29E on reply card

Colmonoy-set diamond tools for specialized grinding-wheel dressing operations are the subject of Catalogue DT-55 being distributed by Diamonds & Tools, Inc. A selected number of the dressing tools made are illustrated and described, together with its line of Colmonoy castings for use as wear-resistant machine components.

Circle 30E on reply card

In Bulletin DR-400 Acoustica Associates, Inc., describes its Model DR-400 ultrasonic portable equipment for production cleaning and degreasing of precision parts, for electroplating, soldering aluminum, degassing molten aluminum, metal cutting, etc. A picture of the 1-knob control unit is shown, and the principle on which it operates is explained.

Circle 31E on reply card

Reference Book 39-5 is a 28-page catalogue issued by Homestead Valve Manufacturing Company on its new straightway, 3-way, 4-way or multiple-port lubricated plug valves designed for 250 pounds oil-water-gas and 150 pounds steam working pressures and for 100 percent or restricted flow. They are made in a wide choice of metals and sizes.

Circle 32E on reply card

Mechanipak, a package-type mechanical seal that is ready to install, has been announced by The Garlock Packing Company and is described and illustrated in Bulletin AD-150. It is designed for use on $\frac{3}{4}$ - to 3-inch rotary shafts at pressures up to 150 psi and furnished with synthetic rubber or silicone bellows, depending upon operating pressure and temperature.

Circle 33E on reply card

Masonry Preservation, a 16-page brochure released by The Tremco Manufacturing Company, discusses waterproofing problems and their solutions. Based on laboratory and field experience, it covers a number of pertinent subjects, including the various kinds of masonry used, the effects of moisture absorption and vapor migration and methods of calking and pointing joints prior to applying the preservative.

Circle 34E on reply card

The American Society of Mechanical Engineers has available for showing without charge to schools, television stations and nonprofit organizations a 25-minute 16-mm motion picture entitled *To Enrich Mankind*. The purpose of the film is to explain the significant role mechanical engineering plays in the development of our country. Requests should be addressed to Barbara A. Brown, Public Relations Dept., ASME, 29 West 39th Street, New York 18, N. Y.

Additional technical information on AM 350, the new stainless steel that bridges the gap between the 300 and 400 series, is given in a 10-page booklet offered by Allegheny

35,000 P. S. I. COMPRESSORS Sealed with FRANCE HYPER PACKINGS

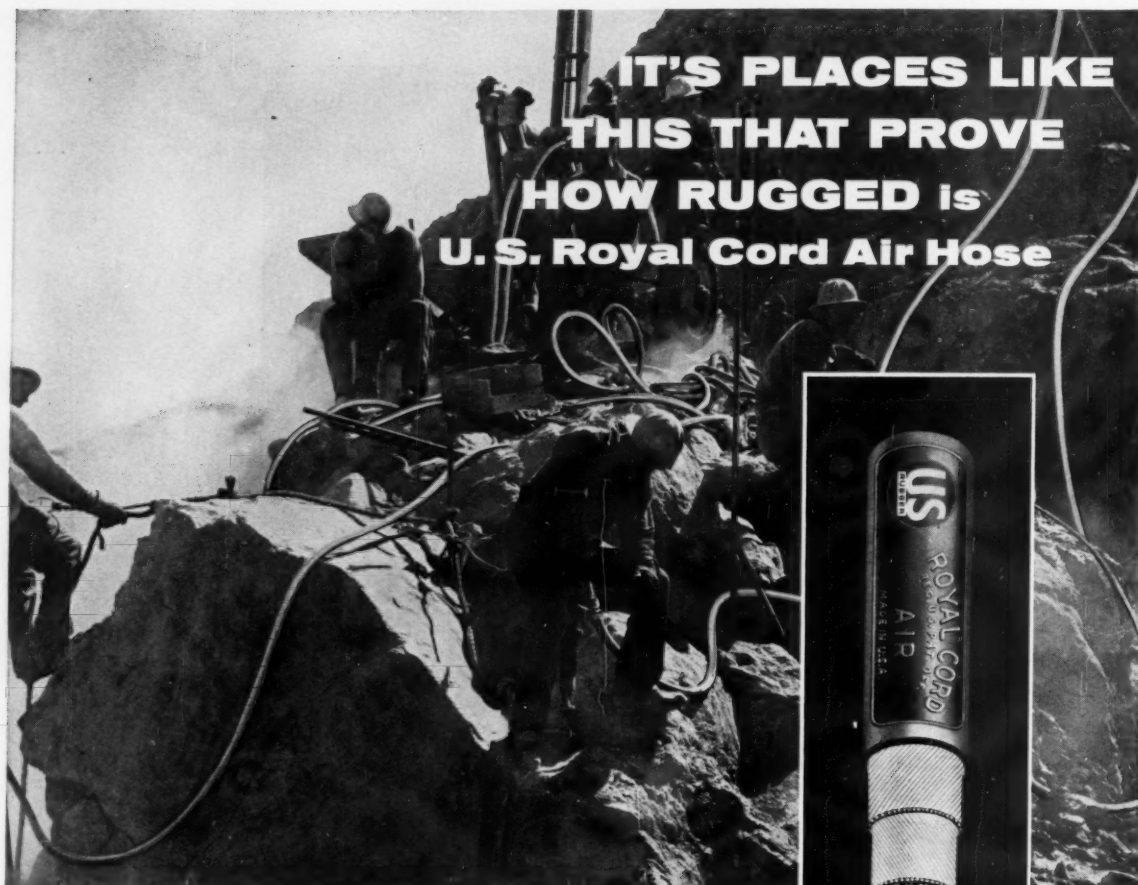
The extremely high pressures now required by some chemical processes have created a new field for compressors and posed problems for mechanical packings considered impossible until France Hyper Packings proved these problems could be solved.

As builders of mechanical packings for nearly 60 years France has lived intimately with the problem of developing special packings for Industry.

The high degree of engineering and craftsmanship required for special service is reflected in the development and production of standard types of packings, piston rings and valve discs.

FRANCE
PACKING CO., PHILA. 15, PA.

Circle 24A on reply card



**IT'S PLACES LIKE
THIS THAT PROVE
HOW RUGGED is
U.S. Royal Cord Air Hose**



It's built like a tire!

That's right! U.S. Royal Cord is built like a tire... *it has to be*, to take the battering it gets on all kinds of jobs, under extreme pressures. U.S. Royal Cord is hit by rocks in blasting; heavy tools fall on it; trucks and other vehicles roll over it; workmen pull it over jagged rocks. But U.S. Royal's unique cord construction, borrowed from "U.S." tiremakers, lets U.S. Royal come through unharmed. Needs no cribbing. Despite its great strength, this hose is very light and flexible.

- Tube of high quality neoprene for maximum oil resistance.
- Braided cotton breaker ply anchors tube to carcass everlastingly.

- *Exclusive:* Two counter-spiraled plies of tough special yarn floated in resilient rubber for outstanding strength, shear resistance and flexibility.

- Tough, brown, natural rubber cover (strongest ever put on a molded hose) gives excellent cut and abrasion resistance.

Buying second-rate, short-lived hose is no short-cut to economy. Get "U.S." quality hose for the biggest savings. No matter what your hose problem may be, "U.S." can solve it. Get in touch with any of United States Rubber Company's 27 District Sales Offices or write address below. You will obtain the correct job-engineered hose, and the guidance and advice of an expert staff of "U.S." engineers.



"U.S." Research perfects it... "U.S." Production builds it... U.S. Industry depends on it.

UNITED STATES RUBBER COMPANY
MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes
Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

Ludlum Steel Corporation. Included are tables on mechanical properties, stress rupture properties, elevated-temperature tensile properties, corrosion rates in various media and effects of cold rolling and aging on hardness and tensile properties.

Circle 35E on reply card

The Bellows Company is distributing Bulletin ML-3 devoted to its line of controlled-air-power devices. Full color illustrations show its air motor and interchangeable valves, as well as numerous industrial applications. Other standard items also are described and shown.

Circle 36E on reply card

Bulletin 71-B-1 released by Bucyrus-Erie Company illustrates and describes in detail its Model 71-B shovel of 3 cubic yards capacity. Powered by a 6-cylinder engine, the machine can be readily converted into a dragline, clamshell or crane and incorporates the basic engineering features of the company's line of general-purpose excavators.

Circle 37E on reply card

Bulletin A-8 recently published by New Jersey Meter Company describes and shows applications of its Tool-ometer and Drill-ometer for checking pneumatic tools and equipment to keep them in effective operating condition. The meters are rated in cubic feet of free air per minute based on a working pressure of 80 psi and may be used at any pressure from 1 to 300 psi.

Circle 38E on reply card

Ductile Cast Iron is the title of a 15-minute sound-color film produced by The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y., and is available for use by industry, technical societies and educational institutions. The motion picture is the result of five years of production experience and use of this metal, which has properties similar to steel.

A general tubing catalogue containing information required for the proper selection and application of 46 principal analyses of tubing has been published by Superior Tube Company. Designated as Bulletin 40, the brochure divides the analyses into five groups: stainless steel, nickel and nickel alloys, carbon and alloy steels, beryllium copper and titanium.

Circle 39E on reply card

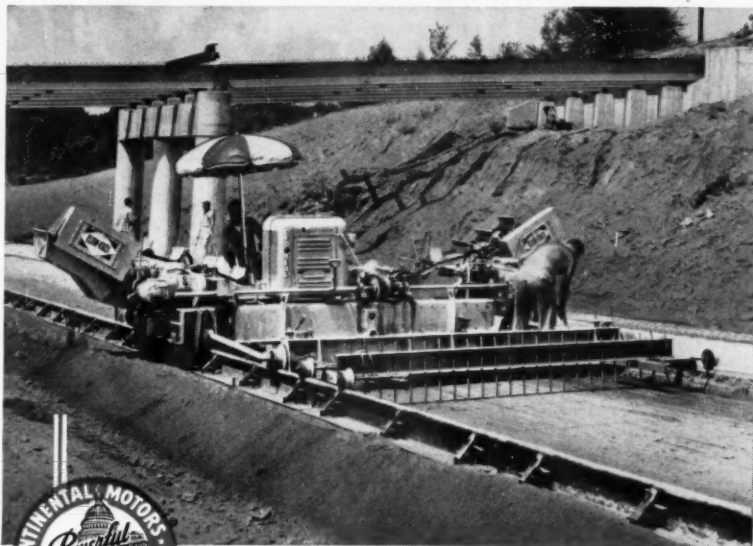
A 23-page bulletin, VM-101, which includes both general information and technical data on vacuum-melted metals and alloys has been issued by the Carbonyl Department of General Electric Company. It covers the effects of vacuum melting on the properties of various metallic materials and the benefits of the process to the user. Fabricating and machining methods are recommended and engineering data are given on M-252 and J-1570, two new high-temperature alloys now in production.

Circle 40E on reply card

Ingersoll-Rand's complete line of hydraulic drill booms (Hydra Booms) for use in the construction and mining industry are dealt with comprehensively in a 12-page bulletin (Form 4162) available upon request. Units mounted on tractors, jumbos and self-propelled air-operated rigs are described and pictured at work and their advantages over wagon- and column-type drill mounts are discussed. Also included are diagrammatic sketches showing the area each boom can cover from one position both horizontally and vertically, together with information on special mountings and accessories.

Circle 41E on reply card

Putting the Thruway Thru

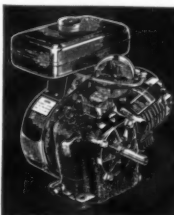


... with a Big Assist from
Red Seal Power

Specialized machines such as this Model "GB" Blaw-Knox Precision Subgrader account for the amazing rapidity with which the highway network is expanding to meet this country's needs. This unit, with its extra discharge horn permitting discharge of spoil at either end, is only one of a steadily-lengthening list of special-purpose equipment utilizing Red Seal power. You find Red Seals, today, building prestige for the makers—and earning profits for the users—of leading makes of pavers, graders, mixers, compressors, earth-movers, ditchers, shovels, rollers and numerous other machines. You can clinch on-time performance by standardizing on equipment which offers the plus-value of dependable Red Seal power.

4-CYCLE ENGINES FOR INDUSTRY AND FARM

In addition to its large engines, Continental builds an outstanding line of heavy-duty air-cooled four-cycle models for farm and industrial applications requiring 2 to 3 h.p. Advanced engineering gives them easy starting, high dependability, and unusual lugging capacity at low speeds . . . Op-



tions: patented and exclusive Contex® external ignition system, low-level ignition cut-off, 6-1 reduction gear, and other features. Available also for use on kerosene . . . For information on these models, address Air-Cooled Industrial Engine Division, 12800 Kercheval Ave., Detroit 15, Michigan.

SERVICE FACILITIES AND GENUINE RED SEAL PARTS
ARE AVAILABLE EVERYWHERE

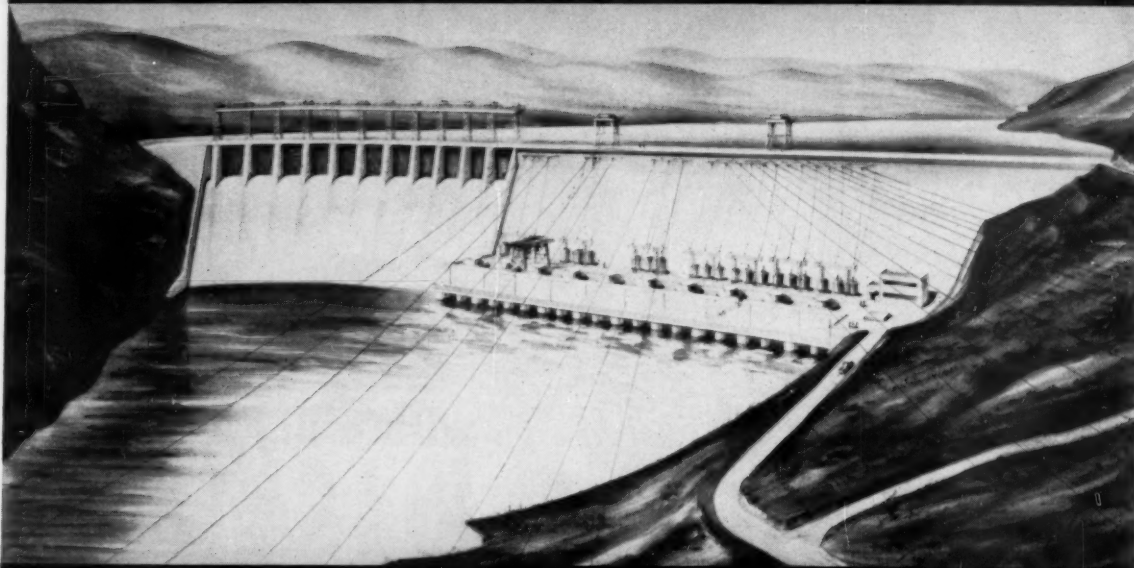
Continental Motors Corporation

MUSKEGON • MICHIGAN

6 EAST 45TH ST., NEW YORK 17, NEW YORK • 3817 S. SANTA FE AVE., LOS ANGELES 58, CALIF.
6218 CEDAR SPRINGS ROAD, DALLAS 9, TEXAS • 910 S. BOSTON ST., ROOM 1008, TULSA, OKLA.
1252 OAKLEIGH DRIVE, EAST POINT (ATLANTA) GA.

Circle 26A on reply card

drilling for 400,000



KW of electricity...

Some 200 miles north of Sao Paulo, Brazil, Ebasco Services is engineering and constructing the Peixoto Hydro Electric Development, for Cia. Paulista de Forca e Luz. When completed, the harnessed waters of the Rio Grande will furnish 400,000 KW of electricity for the industrial development of the area.

To build the dam and accessways to it, meant moving many hundred tons of earth and rock — and for that big job Crucible Hollow Drill Rods were chosen. Experienced construction men *know* they can depend upon these rods for *optimum* performance at *lowest cost per foot of hole drilled*.

That's because Crucible Hollow Drill Rods are built to *tool steel* standards, by the leading producer of tool and special purpose steels. That means fewer broken rods or valuable bits lost on the job. So be sure that on your drilling jobs you specify Crucible Hollow Drill Rods. *Crucible Steel Company of America, Henry W. Oliver Building, Pittsburgh 30, Pa.*

CRUCIBLE

first name in special purpose steels

Crucible Steel Company of America

Mining Rock Salt 1000 Ft. Underground **WHERE EXPLOSIVES RESEARCH PAYS OFF**



Using ladders, the blasting crew loads cartridges of Hercomite® into the upper rows of drill holes in a 24-ft. high working face 1,000 ft. underground in Jefferson Salt Company's mine in Louisiana.

Primed with regular and short-period delay electric blasting caps made by Hercules, the blasts produce excellent fragmentation, affording economical recovery by power shovels and uninterrupted processing operations in the plant on the surface.

The development, manufacture, and use of specialized types of explosives have been Hercules' business for over forty years. Our knowledge of explosives and blasting techniques is at your disposal in solving blasting problems in mining, quarrying, construction, or wherever explosives are used.

Explosives Department

HERCULES POWDER COMPANY

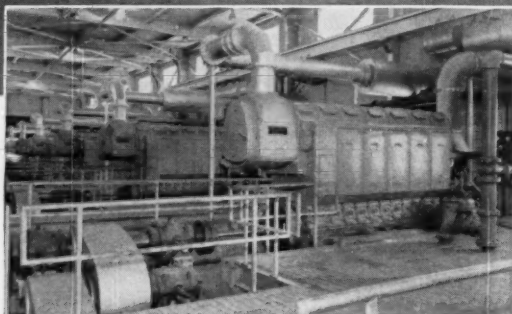
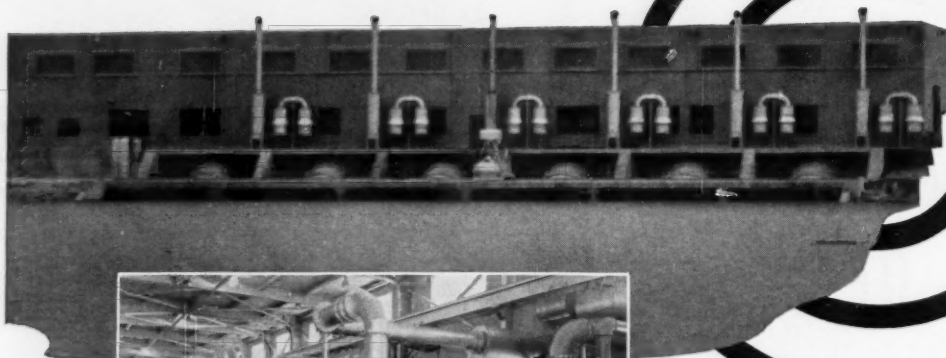
932 King St., Wilmington 99, Del.

BIRMINGHAM, ALA.; CHICAGO, ILL.; DULUTH, MINN.; HAZLETON, PA.; JOPLIN, MO.; LOS ANGELES, CAL.; NEW YORK, N. Y.; PITTSBURGH, PA.; SALT LAKE CITY, UTAH; SAN FRANCISCO, CAL.



XR55-6

WORLD'S LARGEST . . . and a perfect TARGET for DUST!



Twelve Type W Cycoils clean scavenging air for six 1600-hp. diesels (shown in inset) at Station 5-A—world's largest low-lift pump plant located midway between Lake Okeechobee and West Palm Beach, Fla.

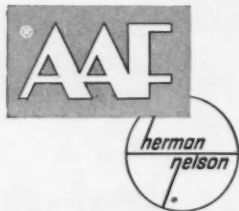
New Florida Pumping Station "Plays it Safe" by Installing Cycoil Oil Bath Air Filters

Everything about Station 5-A is "big". Its six pumps have a daily capacity of over 3 billion gallons—that's three times the daily water consumption of New York City. Powering these pumps are six 1600-hp. Fairbanks-Morse Diesels. Their combined job—to protect Florida against rampaging floods and devastating droughts through year 'round control of Lake Okeechobee.

Recognizing the importance of this operation, action was taken to insure that dust will never become "a monkey

wrench in the machinery". Two Type W Cycoils placed at air intake of each of the six Diesels guarantee freedom from dust damage. Two-way cleaning action of these oil bath filters leaves nothing to chance. Thorough mixing of oil with intake air traps 90% of the dust content. The remaining 10% falls easy prey to Cycoil's filter pads.

Cycoil's complete protection costs but a fraction of a major shutdown to repair the damages of dust. For complete product information, write for Cycoil Bulletin 130.

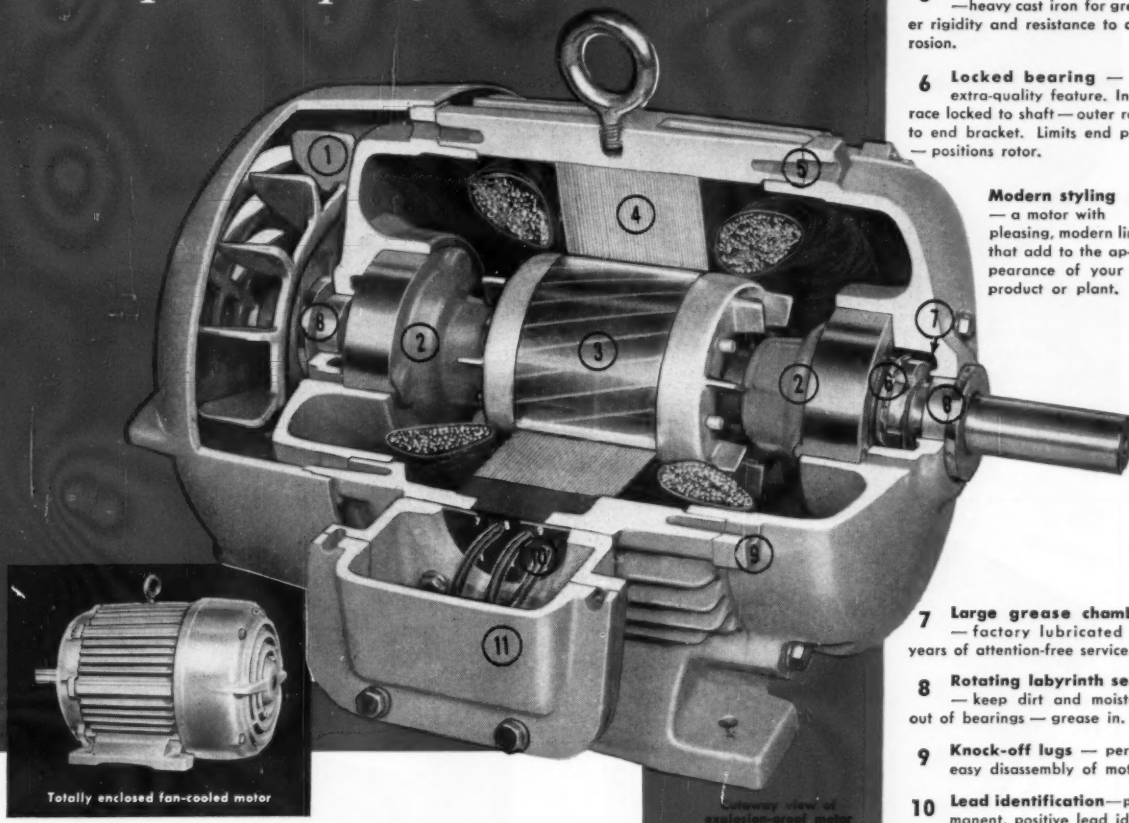


American Air Filter

COMPANY, INC.

American Air Filter of Canada, Ltd., Montreal, P. Q. • 402 Central Avenue, Louisville 8, Kentucky

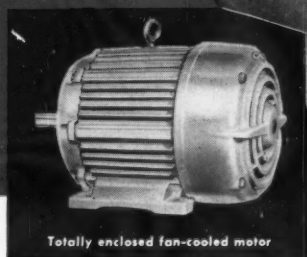
Here's the inside story of
the NEW L.A. Line
...your BEST enclosed
and explosion-proof motor BUY



- 1 Fan** — efficient, non-sparking fan. New aerodynamic design for more effective cooling.
- 2 Inner bearing cartridges** — lock bearings to end bracket and form explosion-quenching seal along shaft.
- 3 Indestructible cast-aluminum rotor**—dynamically balanced with fan for smooth, quiet operation.
- 4 Stator** — prewound stator core utilizes Formvar wire insulated with a new Alkyd Asphalt Resin insulating varnish.
- 5 End bracket and housing** — heavy cast iron for greater rigidity and resistance to corrosion.
- 6 Locked bearing** — an extra-quality feature. Inner race locked to shaft — outer race to end bracket. Limits end play — positions rotor.

Modern styling
 — a motor with pleasing, modern lines that add to the appearance of your product or plant.

- 7 Large grease chamber** — factory lubricated for years of attention-free service.
- 8 Rotating labyrinth seals** — keep dirt and moisture out of bearings — grease in.
- 9 Knock-off lugs** — permit easy disassembly of motor.
- 10 Lead identification**—permanent, positive lead identification spacer in conduit box.
- 11 New split conduit box** — rugged cast-iron conduit box diagonally split for easy connection.



Totally enclosed fan-cooled motor

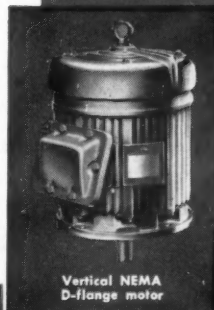
This is the completely new L.A. totally enclosed fan-cooled and explosion-proof motor. Every feature in this new line is designed for easier installation, longer service life, less maintenance and attention. You get the full benefit of the new NEMA standards in a smaller, more functional, completely modern design.

Your nearby Louis Allis Sales Engineer can show you all the reasons why these motors perform better and longer on your tough jobs — why they give you maximum resistance to corrosion wherever you need this extra protection. Call him today.

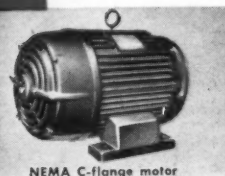


THE LOUIS ALLIS CO.
 MILWAUKEE 7, WISCONSIN

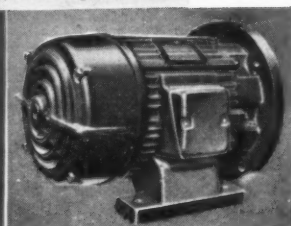
LA-103



Vertical NEMA D-flange motor



NEMA C-flange motor



NEMA D-flange motor

We specialize in SPECIAL MOTORS —
and PROMPT DELIVERY, TOO

There's a Louis Allis special motor for your toughest application. Whatever electrical or mechanical modifications you need, check first with Louis Allis.

DRI AIR MAY BE INSTALLED BY SUSPENDING IT FROM THE PIPING WITHOUT ANY OTHER SUPPORT.

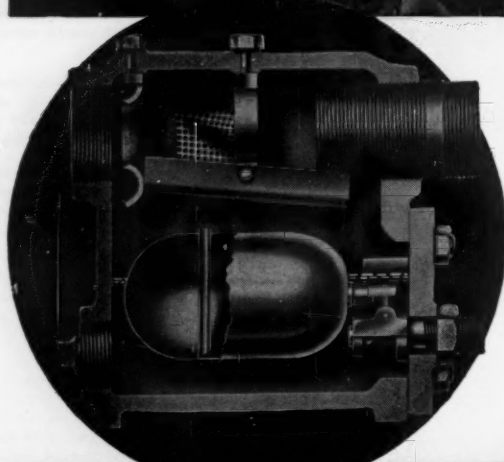
INCREASED PNEUMATIC EFFICIENCY WITH THIS AUTOMATIC SEPARATOR

PROTECT EQUIPMENT WITH

DRIAIR

SEPARATES • COLLECTS • DELIVERS

• DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.



A TYPICAL INSTALLATION SHOWING DRI AIR STANDING ON A CONCRETE FLOOR NEXT TO THE WALL.



WRITE FOR BULLETIN DA WHICH FULLY DESCRIBES THE CONSTRUCTION AND OPERATION OF THE DRIAIR.

NEW JERSEY METER CO.

"SPECIALISTS IN COMPRESSED AIR DEVICES"

PLAINFIELD,

NEW JERSEY

Circle 31A on reply card



BUY BOTH BOOKS FOR \$5.00

Price Individual Books	Per Copy
Compressed Air Data.....	\$3.00
Cameron Hydraulic Data.....	3.00

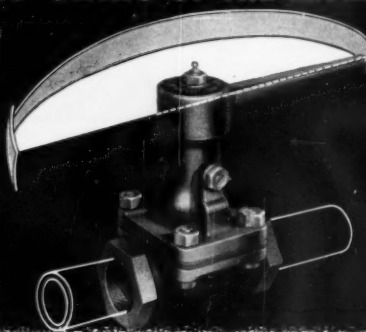
COMPRESSED AIR MAGAZINE, 942 Morris Street, Phillipsburg, New Jersey. Please send me:

- ☐ Compressed Air Data and Cameron Hydraulic Data..Both books for \$5.00
- ☐ Compressed Air Data.....\$3.00
- ☐ Cameron Hydraulic Data.....\$3.00
- ☐ Enclosed is (money order) (check) for \$..... ☐ Send books C.O.D. I understand that the books will be sent me postpaid, and that they may be returned within 10 days if not satisfactory.

Name.....
Company.....
Street No.....
City.....State.....Country.....

with this corrosion resistant valve...

YOU GO FROM FULL OPEN TO FULL CLOSED IN A 180° SWING OF THE LEVER



HILLS-McCANN

Quick Opening

SAUNDERS PATENT DIAPHRAGM VALVES

Dependent upon materials and size, Hill-McCanna Saunders Patent Valves are suitable for temperatures to 400°F., pressures to 150 psi. Write for descriptive literature.

HILLS-McCANN

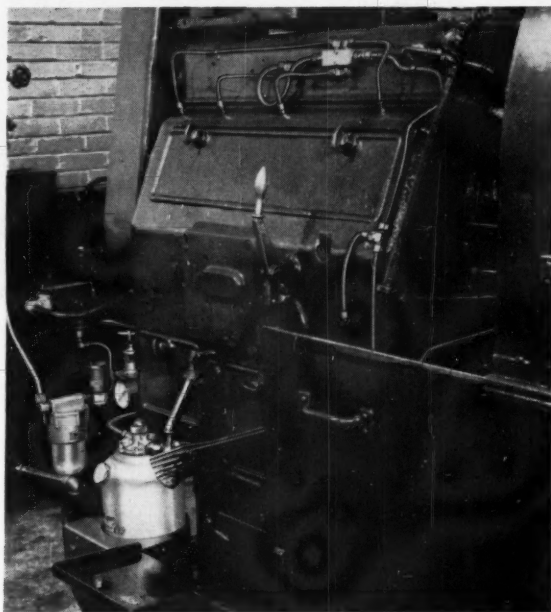
Saunders Patent
diaphragm valves

HILLS-McCANN COMPANY, 2361 Nelson Ave., Chicago 18, Ill.

Circle 32A on reply card

here's typical example of how
manufacturers reduce maintenance
costs and protect equipment
against air line contaminants

with **NORGREN** **AUTOMATIC-DRAIN FILTER**



An automotive electrical equipment manufacturer uses a Norgren Automatic-Drain Filter, Model 11,200-2(25), to protect bearings and component parts of a 9/16" automatic screw machine against air line contaminants.

**Norgren Automatic-Drain Filter (1/4", 3/8", 1/2" sizes)
for air tools, air cylinders and Micro-Fog Lubrication
systems offer these advantages:**

1. Removes abrasive grit and pipe scale.
2. Solids are filtered out before air enters drain chamber, reducing possibility of plugging drain mechanism.
3. Removes corrosive moisture.
4. Drains collected moisture automatically.
5. Discharges only under full load to reduce wear and loss of air.
6. Drain operates independently of air pressure fluctuation and air flow.
7. Prevents contamination of oil supply.
8. Low pressure drop.
9. Reduces air line maintenance operations.
10. Cuts air equipment repair costs.

Flow: 0 to 35 cfm.

Pressure: 30 to 150 psi.

Write for
Complete Data



Circle 33A on reply card

OCTOBER, 1955

**FASCINATING! HOSE COMES TO LIFE WITH
PUNCH-LOK HOSE CLAMPS!**

"A simple operation and Punch-Lok puts your hose in use again," say Doc Punch and Mr. Lok. For complete product and price information, see your near-by Punch-Lok distributor, or write direct.

PUNCH-LOK Company

Dept. H, 321 North Justine Street, Chicago 7, Illinois

"The sign of a GOOD Hose Clamp"

Circle 34A on reply card

Adv. 36



deep in the heart of the

U.S.S. NAUTILUS

I-R equipment performs three vital functions

In service deep in the sea for months at a time, every part of the world's first atom-powered ship must meet the highest standards of dependability. For three of her most vital functions, the Nautilus depends on Ingersoll-Rand units:

BOILER FEED is handled by an I-R multi-stage vertical pump that is small, light, simple in construction and highly efficient. A duplicate unit is on standby service.

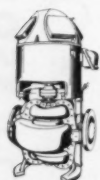
BRINE EJECTION from sea water evaporators that supply distilled water is handled even far beneath the surface. The "brine-over-board" pump

is another I-R Cameron multi-stage unit with construction features similar to those of the boiler feed pump.

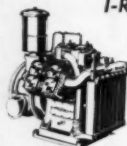
TORPEDO FIRING, the heart of the Nautilus' offensive power, gets the kick to launch the explosive "fish" from two I-R high-pressure compressors. These units also charge storage tanks with air for later use.

In the U.S.S. Nautilus, as in every other application, Ingersoll-Rand equipment meets the tests of rugged dependability and minimum maintenance.

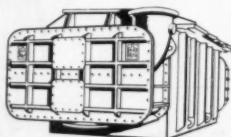
I-R EQUIPMENT FOR MARINE SERVICE



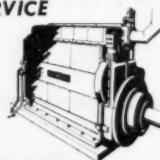
CENTRIFUGAL PUMPS



AIR COMPRESSORS



SURFACE CONDENSERS



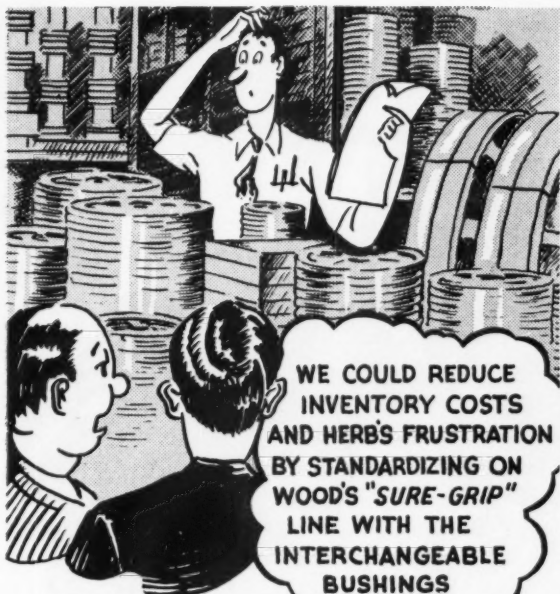
DIESEL ENGINES



AIR TOOLS

Ingersoll-Rand
10-261 11 Broadway, New York 4, N. Y.





You can now meet nearly all your requirements and yet carry fewer pulleys, sheave and coupling sizes in stock, thus materially reducing inventory costs. Remember, standardize on Wood's.



T. B. WOOD'S SONS COMPANY

CHAMBERSBURG, PA.

Cambridge, Mass.

Newark, N. J.

Dallas, Texas

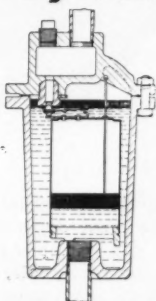
Cleveland, O.

Circle 36A on reply card

THIS AIR TRAP is not stopped by oil

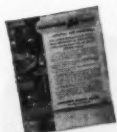
NOW you can get dependable, automatic drainage of water from compressed air intercoolers, aftercoolers, receivers and separators even though the compressor is pumping heavy oil. Any oil reaching Armstrong Inverted Bucket Air Traps collects at the top and is discharged ahead of the water.

Armstrong Air Traps have a simple, proven design; there's nothing to stick, bind or clog. Stainless steel mechanism resists corrosion. For pressures to 600 lbs. *Guaranteed to Satisfy.*



Inverted Bucket Air Traps.

Side-inlet side-outlet styles available.



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885 Maple Street • Three Rivers, Michigan

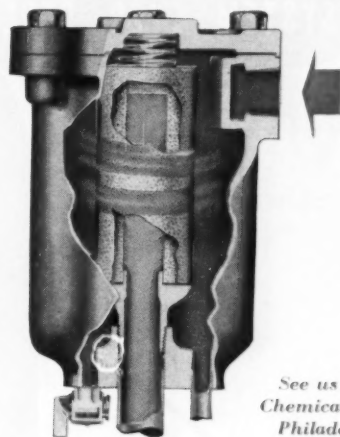
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GIVING DETAILS



Manufacturers of the well known ARMSTRONG STEAM TRAP

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Get Clean Air for Your Tools



See us at the
Chemical Show,
Philadelphia,
Booth 410.

Adams Poro-Stone Air Filters **SAVE** **MONEY • TIME**

You get protection that counts with Adams Poro-Stone Air Filters. Damaging water, rust contaminated oil, dust and pipe scale are removed from your compressed air . . . and there's virtually no pressure drop across the Adams filter.

Separation of foreign matter is in two stages — by centrifugal action from the movement of the air itself . . . by diffusion through the permanent Poro-Stone filter tube.

Not only do you save money in longer tool life and trouble-free operation, but also you save time. That's because Adams filters are quick to clean . . . have no moving parts to wear . . . need no special tools . . . proper assembly is all but fool-proof.

For full details and prices, write today for your copy of New Bulletin 117.

R. P. ADAMS CO., INC.

209 E. PARK DRIVE

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BUFFALO 17, NEW YORK

Please rush me your New Bulletin 117 with sizes and prices.

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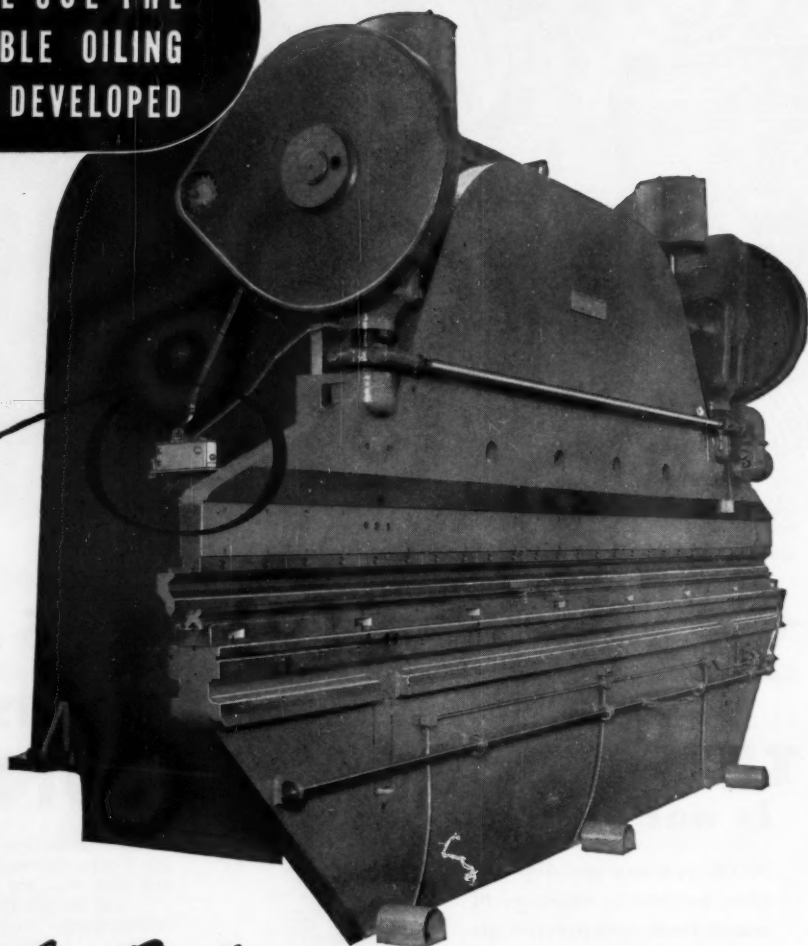
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**MACHINES OF GREAT
PERFORMANCE USE THE
MOST DEPENDABLE OILING
SYSTEM EVER DEVELOPED**

Illustrated is Madison-Kipp Lubricator Model FD installed as original equipment on a 36" by 20" Cincinnati Press Brake, manufactured by the Cincinnati Shaper Co., Cincinnati, Ohio.



MADISON-KIPP

Fresh Oil

... by the measured drop, from a Madison-Kipp Lubricator is the most dependable method of lubrication ever developed. It is applied as original equipment on America's finest machine tools, work engines and compressors. You will definitely increase your production potential for years to come by specifying Madison-Kipp on all new machines you buy where oil under pressure fed drop by drop can be installed.

MADISON-KIPP CORPORATION

202 Waubesa Street, Madison 10, Wis., U.S.A.

ANCIENS ATELIERS GASQUY, 31 Rue du Marias, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

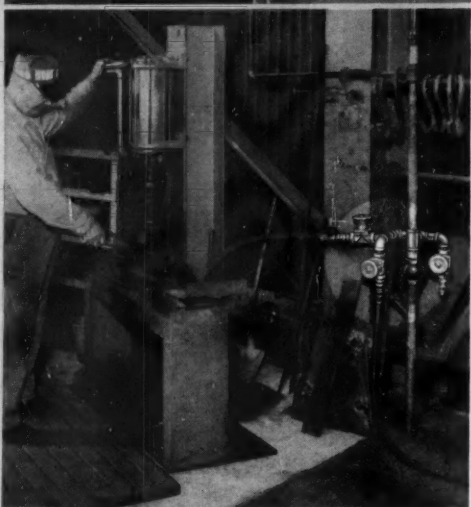


- *Skilled in DIE CASTING Mechanics*
- *Experienced in LUBRICATION Engineering*
- *Originators of Really High Speed AIR TOOLS*

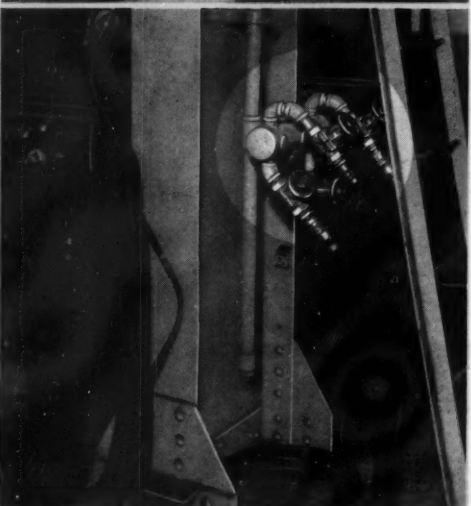
Hose outlets with quick coupling fittings attached to Grinnell-Saunders Valves at Lehigh Structural Steel Company.



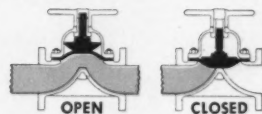
Outlet valves for this rod bender are Grinnell-Saunders.



4-outlet air manifold equipped with Grinnell-Saunders Valves.



"Lower air costs... increased productivity, with Grinnell-Saunders Diaphragm Valves"

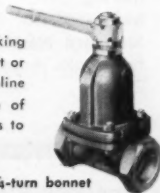


At Lehigh Structural Steel Company, compressed air now goes to work—not to waste. Upon discovering that a large percentage of its compressed air supply was being wasted through leakage, this Allentown, Pa. firm began a major review and overhaul of its entire system. The main cause of the trouble was found to be in the outlet valves which could not be kept in proper working condition.

To determine which type valve would stand up best under prevailing service conditions, a number of different valves were installed and the results compared. Based on these impartial "on-the-job" tests, Grinnell-Saunders Diaphragm Valves were approved—and were installed throughout the entire system.

Here is another instance of the economy of Grinnell-Saunders Diaphragm Valves... in use by more and more industries where low maintenance, long service, and complete dependability are demanded.

Features: complete isolation of working parts, leak-proof closure even with grit or scale in line, high lift for full streamline flow, freedom from clogging, choice of diaphragm materials and body linings to suit service, and easy maintenance.



QUICK-ACTING, 1/4-turn bonnet

GRINNELL

WHENEVER PIPING IS INVOLVED

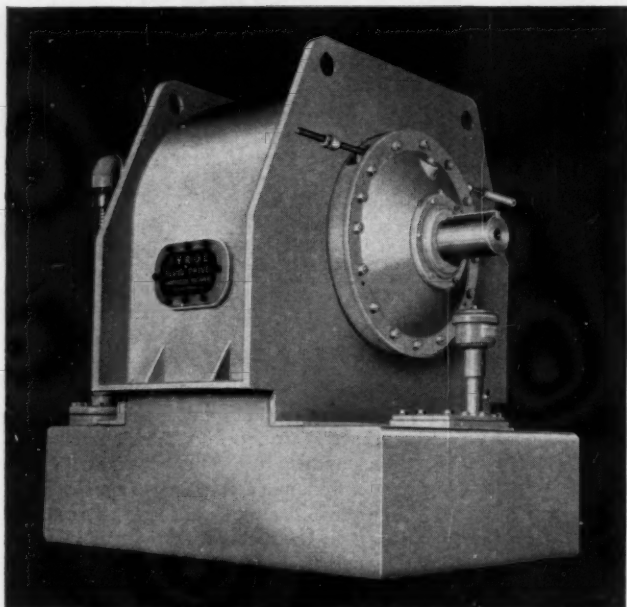


Grinnell Company, Inc., Providence, Rhode Island

Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
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New American Blower Gýrol Fluid Drive



American Blower's packaged Type VS Class 2F Gýrol Fluid Drive is available from 400 to 1000 hp for operating speeds up to 1200 rpm; fits standard 18-inch-channel oil-fields skids.

designed for tough, oil-field application

The latest American Blower Gýrol Fluid Drive, Type VS Class 2F, is specifically designed for compounding multiple-drive engines on oil-drilling rigs. Because of its excellent cushioning ability, this Gýrol Fluid Drive can be used effectively with any compound design, and provides great flexibility in manipulating pumps.

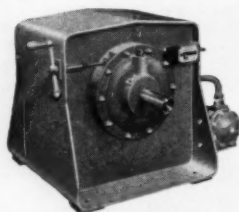
Type VS Class 2F Gýrol Fluid Drive is ruggedly built to meet the long-life service required in rotary, slush-pump, and draw-works operations. It is a self-contained unit — permits infinite adjustment of speed and torque over a wide range.

Under all operating conditions, maximum engine torque can be exerted without danger of stalling the engine — and absolute control of the rate of acceleration produces maximum conservation of engine power.

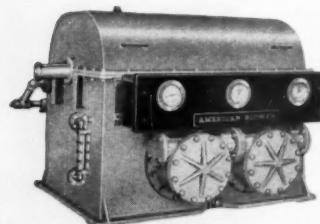
Whatever your application, the new Type VS Gýrol Fluid Drive will provide dependable, long-life service. Call your nearest American Blower Branch Office for complete data.

Traction-type Fluid Drives

American Blower Type TM, traction-type fluid drives are also available as complete packaged units containing AC motor and built-in Gýrol Fluid Drive. Standard NEMA mounting bolt hole dimensions. 1 to 20 hp.



Type VS, Class-2, adjustable-speed Gýrol Fluid Drive. Speed range: 5 to 1. Six sizes, 7½ to 800 hp; speeds to 1800 rpm.



Type VS, Class-6, Gýrol Fluid Drive. Adjustable-speed drive for compressors, pumps, and other high-speed applications. 200 to 12,000 hp, to 3600 rpm.

American Blower products serve the petroleum industry

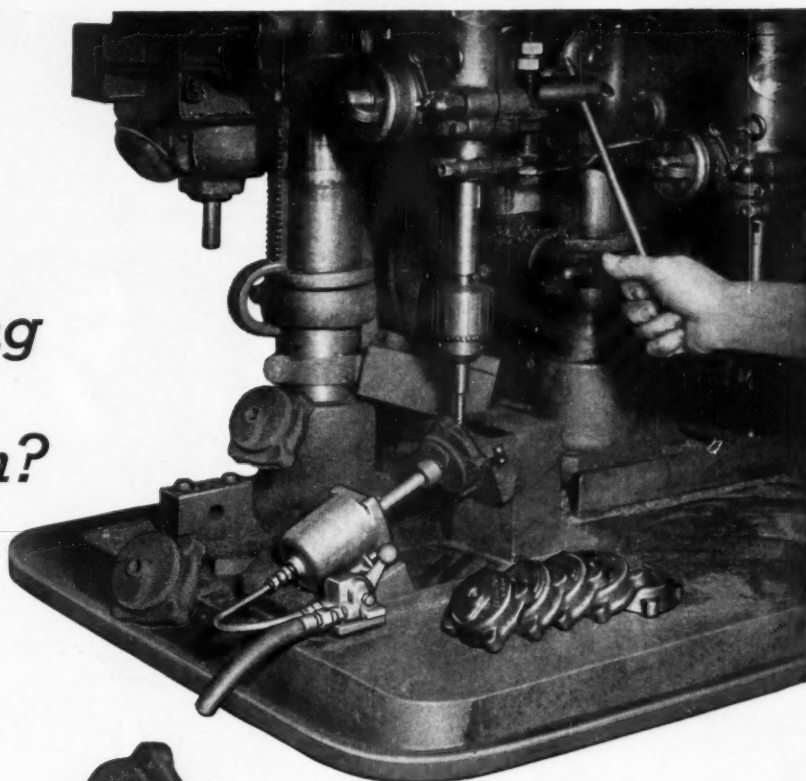
- Air Conditioning, Heating, Ventilating Equipment
- Mechanical Draft Equipment
- Industrial Fans and Blowers
- Centrifugal Compressors
- Gýrol Fluid Drives

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

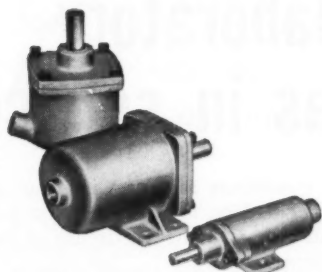
AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

Clamping Problem?



**SCHRADER has
the answer!**



Schrader Air Clamping Cylinders are available either base or leg mounted, in 1", 2 1/4" and 3" diameters delivering a 2" or 1" stroke. A wide selection of Schrader Valves is available to operate this equipment.

Schrader

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Leaders in air control since 1844



The **Schrader Air Clamping Cylinder** is actually a bantam air cylinder that can *add several minutes* to each worker's production hour . . . eliminate the need for slow, manual clamps.

Think of all the clamping operations in your own shop. Milling machines . . . drill presses . . . power presses . . . welders . . . gluers — and many dozens of other machines that are now idling for ten or fifteen seconds while operators go through slow clamping operations. Why not save time — and operator annoyance — with fast, convenient Schrader Clamping Cylinders, as so many other industrial plants have already done? Remember, you can mount these Schrader Clamping Cylinders anywhere — and actuate them automatically or manually.

For full details on the models available — or any of the hundreds of air control products in the complete Schrader Line — write today. Or, if you prefer, fill out the coupon below.

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J. M. CRAWFORD, VICE PRESIDENT AND GENERAL MANAGER OF MOTOR & GENERATOR DIVISION, AND A. H. LAUDER, MANAGER OF LARGE MOTOR & GENERATOR ENGINEERING, INSPECT NEW G-E DEVELOPMENT LAB.

In new G-E development laboratory giant motors perform just as in service

One of the most difficult problems design engineers face is predicting accurately how a large motor will perform under actual operating conditions. G.E. has come up with an answer to this problem.

INCREDIBLY ACCURATE TEST CONDITIONS are made possible by the brand new G-E test laboratory pictured above. A huge synchronous generator with a base rating of 60,000-kva, driven by a variable speed d-c motor, provides current of variable frequency to the equipment on test.

Large a-c and d-c motors and generators, synchronous condensers, and giant hydro-generators can now be

fully tested under conditions more severe than are encountered in the field. You are thus assured your G-E equipment will give you the maximum of long life and efficient operation.

UNDER THIS TEST LAB REALISM, data will be obtained which can be translated by G-E engineers into further design improvements.

Take advantage of this progressive research and bring your large motor and generator problems to General Electric. For more complete information call the nearest G-E Apparatus Sales Office. General Electric Co., Schenectady 5, N. Y.

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Progress Is Our Most Important Product

GENERAL  **ELECTRIC**

where SPARKS mean
DANGER

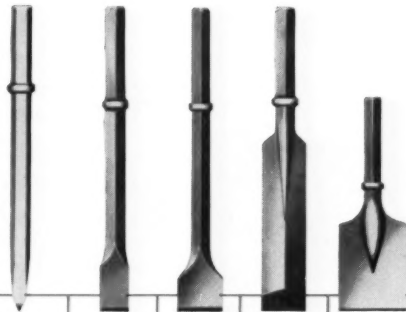
play it safe

with I-R SPARK-RESISTANT paving breaker tools

These FORGED beryllium copper tools stay sharp longer... yet provide maximum protection against spark hazards

● Wherever inflammable or explosive gases are present—wherever striking a spark means DANGER—paving breaker tools of special spark-resistant alloys are a "must".

Now, with this new line of Ingersoll-Rand beryllium copper tools, you can play it safe... and still get far greater tool life than ever before obtainable with this type of equipment. That's because I-R tools are FORGED—not merely cast—of a special high-strength beryllium copper alloy. A trial order will quickly demonstrate their superiority over any spark-resistant paving breaker tools you have ever used. Use them with Ingersoll-Rand paving breakers for peak performance. Write for Bulletin 4127-A.



SHANK SIZE, HEX.	MOIL POINTS	NARROW CHISEL BITS	3" CHISEL BITS	3" x 12" DIGGING CHISEL	5" ASPHALT CUTTER
7/8" x 3 1/4"	×	×	×		
1" x 4 1/4"	×	×	×		×
1 1/8" x 6"	×	×	×	×	×
1 1/4" x 6"	×	×	×	×	×

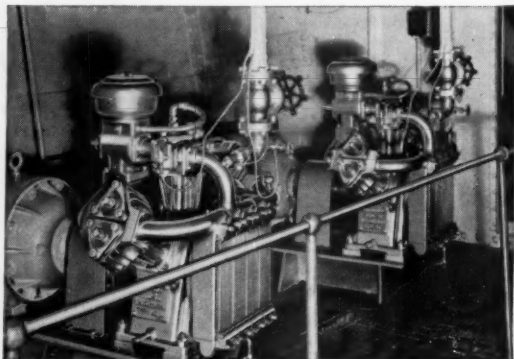
Ingersoll-Rand



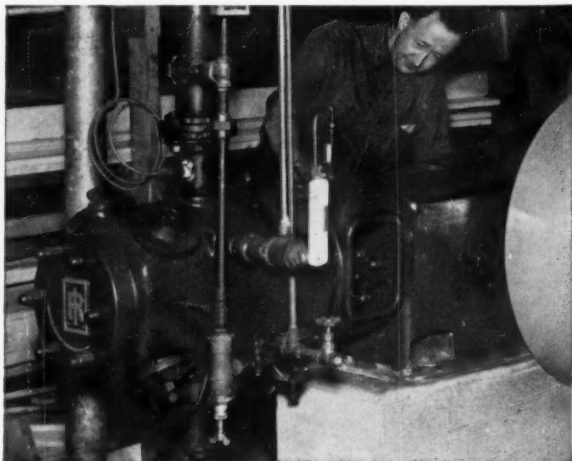
ROCK DRILLS • COMPRESSORS • AIR TOOLS • TURBO BLOWERS • CONDENSERS • PUMPS • OIL & GAS ENGINES

From shops to ships, mints to mines

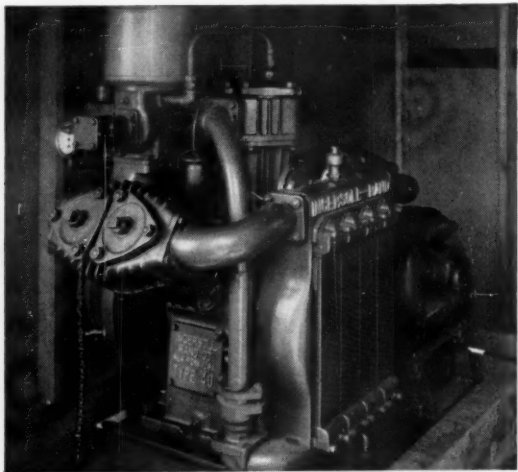
...TIMKEN® bearings help keep compressors trouble-free



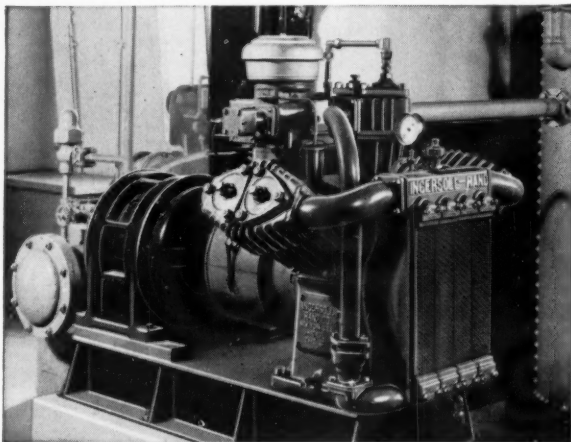
1. SEAGOING COMPRESSORS STAY SHIP-SHAPE—WITH HELP OF TIMKEN® BEARINGS. A tanker gets air for general ship service from these Ingersoll-Rand Type 40 compressors. One reason there's little chance of a breakdown: the crankshaft is mounted on Timken® tapered roller bearings. The shaft and adjacent parts are always held in proper alignment because the tapered design of Timken bearings enables them to take any combination of radial and thrust loads.



2. KEEPS UP PLANT'S AIR SUPPLY WITH TIMKEN BEARINGS TO HOLD DOWN WEAR. This Ingersoll-Rand Class ES compressor supplies a whole plant with air. Its crankshaft is mounted on Timken tapered roller bearings to insure a steady supply and hold down wear. Timken bearings hold wear to the minimum because they practically eliminate friction. Reason: they're designed to roll true and they're made with microscopic accuracy to conform to their design.



3. COMPRESSOR HALTS MINE CARS—TIMKEN BEARINGS HALT WEAR. This Ingersoll-Rand compressor works in an open pit mine. It provides air for air brakes used to spot railroad cars during the loading operation. Crankshaft wear is reduced by mounting it on Timken tapered roller bearings. They're made of steel so fine we have to make it ourselves. We're the only U. S. bearing manufacturer that takes this extra quality step.



4. COMPRESSOR CUTS COST OF MAKING MONEY—WITH HELP OF TIMKEN BEARINGS. Ingersoll-Rand's 25-hp Type 40 compressor supplies the general air in this government mint. To keep the compressor on the job, I-R mounts the crankshaft on Timken tapered roller bearings. Timken bearings handle the crankshaft loads with ease because full line contact between rollers and races gives them load-carrying capacity to spare. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ○ THE TIMKEN TAPERED ROLLER ○

BEARING TAKES RADIAL ⊙ AND THRUST → ⊙ ← LOADS OR ANY COMBINATION ⊙

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